THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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LONDON TRAFFIC FACILITIES.

THE proceedings of the Royal Commission on London Traffic drag their slow course along, without much prospect of coming to an early end. Much of the evidence consists of repetition of what has gone before; granted that the vital points must be driven home by constant iteration, it must be confessed that the process is a trifle wearisome to the spectator.

The iniquitous burden placed upon the shoulders of promoters—even those of the London County Council—by the arbitrary and senseless veto exercised by local authorities; the excessive powers of frontagers to block the traffic of a whole district (with a view to lining their pockets); the injustice of the purchase clause—all these matters have been thrashed out *ad nauseam*. The same is true of the more technical aspects of street traffic, such as the blocking of the roads by standing vans, the obstruction caused by slow and heavy wagons, the virtues of the tramcar, as compared with the omnibus and the tube railway. The fact that the whole system of procedure in connection with the promotion of new tramway undertakings or extensions is antiquated, extravagantly costly, radically defective and unjust, is so obvious that we fear it will be many years before Parliament will be induced to abolish it and adopt new measures free from these and other blemishes. These considerations, however, are somewhat aside from the main question before the Commission—namely, how is the traffic of the Metropolis to be reorganised, co-ordinated and controlled?

It is interesting to note that several witnesses of high standing are in favour of the establishment of an entirely new Tribunal, to have control of the whole question of London traffic, and to be invested with drastic powers, subject only to an appeal to Parliament. This view, for example, was taken by Mr. Stephen Sellon, than whom there is probably no engineer more experienced in the different ways in which municipalities contrive to blackmail and torment companies promoting tramway schemes. Another witness of profound experience in tramway undertakings of all descriptions, both for companies and municipalities, is Mr. J. E. Waller, whose evidence we report this week. Mr. Waller, while fully corroborating Mr. Sellon with regard to the excessive powers of opponents of tramways and light railways, also advocates the formation of a new Street Traffic Board, with absolute legislative powers, subject only to the right of appeal to Parliament. But Mr. Waller goes further, and would empower the Board to deal with street traffic facilities not only in the Metropolitan area, but throughout the United Kingdom.

We are strongly of opinion that the creation of some such Board or Government Department, armed with plenary powers to investigate all new projects, control their execution, and issue regulations for their working, would afford a satisfactory solution of the difficulties which at present harass and impede the efforts of tramway, light railway, and tube railway promoters, be they companies or municipalities.

Why was the Charing Cross Dividend Reduced?

We cannot allow the remarkable action of the directors of the Charing Cross and Strand Electricity Supply Corporation in regard to the dividend on the ordinary shares to pass without expressing the strongest disapproval of the course adopted by them. It is the first time within our experience that a board has gone to its annual meeting with a surprise-packet of this kind for its shareholders, telling *those who may be there* that the official declaration of dividend sent by post was really too generous, and that the directors, for some unknown reason, had been led to further consider the matter, with the unhappy result that shareholders were to have at the rate of 2 per cent. per annum less for the final dividend. No one knows better than directors do, that when dividends are improving shareholders do not trouble themselves to attend the meetings of a company; it is only when they are reduced, or the company is facing Carey Street direction that anything like a representative gathering is to be expected. We have no quarrel with the directors for paying only 8 per cent. for the whole year instead of the 10 per cent. which they gave and then called back; our sympathies are always on the side of a strengthened position rather than an extravagant dividend; but we do quarrel with the indiscretion—for it was nothing short—which allowed them to issue their dividend notice before they had counted the cost. It is impossible for a thing of this kind to happen without leading to multitudinous questionings on the part of shareholders, whose admiration for, and confidence in, the board which could commit such a curious error would not be the greater on its account. To some the question may present itself, "Was there not sufficient ready cash available to pay the proposed dividend?" And it may also be asked whether anything of a special nature occurred between January 25th and February 3rd, the dates of the report and the meeting respectively, which led to need of greater caution. Or, perhaps, we may go even further, and ask, "Did not the board know of its new recommendation until the date of meeting?" If it did, why was not a second notice issued by post cancelling the first? There was the meeting to come, of course, and there might have been some criticism from shareholders, but we trow the latter would have been better satisfied than they are; indeed, it would have been more satisfactory from all points of view. Surely such a decision was not arrived at at a board meeting held just before the annual meeting of the company! Whatever the reason may be, the wavering attitude of the board has besmeared the company's hitherto unblemished financial record.

McMillan Memorial Fund.

In a letter which we publish in our "Correspondence" columns to-day, Mr. H. Edmunds makes an appeal which, so far as it relates to the excellent qualities of the late Secretary of the Institution, and to the necessity of making adequate provision for his widow and children, will strike a chord of sympathy in the hearts of all who were privileged to know Mr. McMillan, and to benefit by his inexhaustible patience and unquenchable goodwill. We are of opinion, however, that our correspondent's action is altogether premature and insufficiently considered, and we fear that his precipitate action may unintentionally result in injury to the cause which he is anxious to promote.

There is no room for doubt whatever that the Institution of Electrical Engineers will take immediate action in the matter. Although, owing to the necessity for going to press with these pages before the result is known, we cannot announce the decision arrived at by the Council at last night's meeting, we anticipate that an official Memorial Fund will be opened, to which members of the Institution of all classes will be invited to contribute; and this, in our opinion—which we know is shared by many of the leading members—is the right and proper course to follow. By dividing forces—which will be the inevitable consequence of the course adopted by Mr. Edmunds—the strength of the appeal will be seriously reduced, and it is even possible that dissension may arise between the supporters of rival funds. That this should happen would be a most deplorable eventuality, and we sincerely trust that no further steps will be taken in the matter until the Council of the Institution has officially announced its programme. We take this course with the earnest desire that the best may be done in the interests of those whose loss is immeasurably greater than ours, great though that be.

The Penny-in-the-Slot System.

It would seem, from certain cases which were heard by Mr. Rose last week at Fulham, that the "penny-in-the-slot system" for the supply of gas does not always work well in practice. Summonses were issued at the instance of the Gas Light and Coke Co. for various sums of money due in respect of gas supplied. It appeared that, some time ago, a man who falsely represented himself to be one of the company's collectors, went round to the consumers, and, by means of a key, opened the meters and stole their contents. Under their form of agreement with consumers, the company were entitled to recover the deficiency, although, as a matter of fact, the gas had been paid for. That agreement provides that "if, from any cause, the money in the meter does not correspond with the amount of gas consumed, the consumer must make good the deficiency." In explaining why this clause had been inserted, the company's solicitor said that it had been found that meters had been robbed by the consumers themselves. Further, it was always competent for a consumer to protect himself by demanding the production of the company's receipt book, which every collector has to carry. In spite of this, Mr. Rose felt himself compelled to make an order for the full amount in each case, but in doing so he expressed the view that "a bargain is a bargain, and these people, having signed an agreement with a harsh clause in it, must abide by its conditions; but I wish I could decide otherwise, because it is an extremely hard case." We have considered it necessary to draw attention to this case in view of the fact that electrical companies have also adopted the pre-payment meter system, and the decision illustrates the importance of the company entering into an agreement of this nature with the consumers. In a case decided in October, 1902, which was duly commented on at the time in the columns of the Electrical Review, the respondents, who supplied gas within their district, erected upon the appellant's premises an automatic slot meter fitted with index dials which registered the quantity of gas passing through it, and there was a box attached to the meter into which shillings could be dropped; on each occasion when a shilling was dropped in a certain quantity of gas passing into the meter. The respondents were the only persons who had the right to open the box, the key of which was kept by them. When the respondents' inspector came to collect the money, the meter showed that 19s. worth of gas had been consumed, but there was no money in the box. The money had been stolen through no negligence on the part of the appellant. The respondents claimed to recover from the appellant 19s. for the gas supplied. It was decided that the appellant by putting the money into the box had paid for the gas, and was not liable to pay again. The agreement which was called in question in the proceedings under notice was probably drawn up for the purpose of avoiding this decision. We commend to every electrical company the advisability of inserting the protective clause in their form of agreement with consumers. If the consumer is sufficiently foolish to

admit an inspector without calling upon him to produce his receipt book, he can only have himself to blame if the so-called inspector proves to have been an impostor.

Electromobile Development.

With the near approach of the Crystal Palace Motor Car Show, the Mecca of the British motorist, we are reminded of the part which, we believe, electricity is destined to play in connection with the automobile industry in the near future.

We can but acknowledge that engineers interested in electrical automobilism were, as a whole, disappointed at the very meagre part which electrical vehicles played in last year's show. Yet we have ample evidence, in the London streets, that electrically-propelled cabs and broughams are steadily gaining in popularity, and that their unequalled adaptability for town work is being more than ever recognised. Unfortunately, the ideal conditions in regard to electrical vehicles, sketched out by Lieut.-Col. Crompton before the Civil Engineers' Congress, seem at the present time as far off as ever.

Even assuming that the electrical vehicle were being turned out in the numbers which are an essential of cheap production and supply, the electrical supply authorities have not apparently grasped the vital necessity for charging at the very lowest rates, and what is of equal importance, at the uniform rates, which would enable the best advantage to be taken of what might well be the cheapest form of locomotion in existence. With our habitual caution, the ingrained "slow coach" policy of the nation, we are content to let slide, what might be an economic revolution in street traction, and with it all, a great accession of business to the electrical engineering world. Given these greater facilities for charging, both in town and country, the electrical van would surely displace all others, and electrically-driven touring cars would be, at least, more in evidence than at present.

The recent New York Automobile Show was prolific in electrical vehicles, which numbered about one-fifth of the total, and showed clearly where electrically-propelled vehicles are appreciated at their true worth. A great many of these were of the commercial type, and, as might be expected, the Edison battery was much in evidence. During the past year the iron and nickel type of cell has come to the fore, both in America and Europe, and preliminary demonstrations of their practical worth have given the automobile world some idea of their future possibilities in regard to automobile work. A novelty in its way among the New York exhibits was on show by the General Electric Co., a set of Exide cells being charged by means of a rectified current, single-phase alternating current being fed through a mercury arc rectifier to the battery. A vehicle by the Baker Co. also embodied some new features, the propelling 2¼ H.P. electric motor being placed in the front hood (usually occupied by the petrol motor), and driving the front axle through bevel gearing. With the exception of these, the New York show did not produce anything radically out of the normal, but we may well hope that its electrical features will find a satisfactory counterpart in our own show, which opens to-day.

Tramway Social.—On Friday evening, January 29th, a "social" was held at the car-shed depôt of the Reading Corporation Tramways, in connection with the Tramways Social and Athletic Club. During the evening the finals of a billiard and draughts tournament were played off, and an interesting collection of photographs and curios which had been contributed by a number of tramways employés who had been engaged on service abroad, was on exhibition in the club room. During the evening selections of vocal and instrumental music were given by several members, and at the close of a very enjoyable evening Mr. Binns, the general manager of the tramways, with a few appropriate remarks, presented prizes to the successful competitors of the tournaments.

TECHNICAL INSTRUCTION IN GERMANY

By W. G. RHODES, D.Sc., M.I.E.E.

I have before me the Diplomatic and Consular Report on "Special Schools and Courses for Mechanical Engineering and Electrotechnics," in Germany, The *Financial Times* for January 11th, 1904, refers to this report, and says :—

"Those who desire to see the facilities for technical education increased in this country as the means of strengthening our hands in the fight for the world's markets, will be much interested in the report by our Consul at Stuttgart on the special school and courses for mechanical engineering and electrotechnics, which was issued by the Foreign Office on Saturday. It is a complement to a previous report on the building and engineering trades' schools, and the two together serve to give a very complete idea of the extent to which scientific training is carried on in Germany. There are 13 engineering schools, with over 2,400 pupils, whose collective results are reviewed, and full details are also given of the works of four or five of the leading technical universities where the teaching of electrical engineering is made a speciality. These latter schools were attended by over 3,600 scholars in 1902, of whom 37 per cent. were foreigners. It is interesting to note that 11 came from the United Kingdom, two from Australia and eight from Cape Colony."

I propose to supplement the reference of the *Financial Times* by inquiring more closely into these German methods of instruction, and then to compare them with our own methods. I will confine my attention to courses of instruction in Electrical Engineering.

To illustrate the case, I take the "Technikum" at Mittweida, which was founded in the year 1867, and was specially organised for purely industrial needs and requirements.

The instruction afforded by the school is of two kinds, or rather degrees—higher and lower. The former is given in the departments for mechanical and electrical engineers, and the latter in the departments for foremen, draughtsmen and inspectors. The special detailed aims of the higher and lower departments are as follows :—

Departments for mechanical and electrical engineers :—

1. Training of future engineers and constructors of the mechanical and electrical engineering branches.
2. Training of future manufacturers of machinery, who must possess at least the same standard of knowledge as the engineers and "Techniker" who are under their orders.
3. Training of future owners of works or industrial undertakings who require single machines or whole systems of machinery for the manufacture of their special products.
4. Training of future managers of engineering works and of the head engineers of branches of industry.
5. Training of future consulting engineers and patent agents.
6. Training of technical commercial travellers.

Departments for mechanical and electrical foremen, inspectors and draughtsmen :—

1. Training of skilled workmen and mechanicians who wish to become foremen, inspectors, draughtsmen and fitters.
2. Training of future owners of small works.

The courses of instruction last five or six terms (two and a-half or three years) for mechanical and electrical engineers, and three terms (one and a-half years) for mechanical and electrical foremen, inspectors, draughtsmen, &c. They are most carefully arranged to suit the degree of previous education and practical knowledge possessed by intending pupils.

The plans of instruction in the department of electrical engineering are three in number. Nos. I. and II. aim at a higher degree of instruction in electrical engineering, No. III. at a lower degree. Nos. I. and II. give practically the same instruction, but No. I. is arranged for a period of five terms of one half-year each. This has been devised to suit the degree of preliminary educational qualifications possessed by pupils attending Nos. I. and II. Pupils of No. I. possess a better standard of general education, and require, therefore, only five terms of technical instruction ; pupils of No. II. possess a lower standard of general education, and require, therefore, six terms of technical instruction. The result is that the hours and subjects of instruction differ at the

beginning of the two courses. I. and II. approach each other towards the middle, and are practically identical at the end.

The plan of instruction No. I. (duration 2½ years) for electrical engineers—

Pupils who possess the educational qualifications for the one year military service or higher educational qualifications are admitted at once.

Pupils who cannot produce these qualifications must produce proof of a good general education, and a knowledge of elementary arithmetic, algebra, and planimetry. These proofs must be adduced in the form of school certificates. If these are lacking, the pupil must undergo an entrance examination. If he passes this satisfactorily, he is admitted to Plan of Instruction No. I.; if he does not pass, he can undergo a course of private tuition, and can present himself again for examination, or—and this is generally the case—he may at once enter the course given under Plan of Instruction No. II., which lasts one term longer than No. I., but provides practically the same instruction. A period of one year's practical work before entrance is considered highly desirable, and those pupils who have omitted to fulfil this most important condition are requested to rectify this omission in some manner or other during their course of study. Those pupils, however, who wish, after the completion of the course, to obtain the diploma of electrical engineering, must either have undergone this period of at least one year's practical work before entering, or must interrupt their studies after the second term of No. I., or the third term of No. II., in order to undergo at least one year's practical work. For the purpose of practical work, middle-sized engineering or electrical works are considered most suitable, and pupils are recommended to work the same hours and observe the same rules and regulations as the ordinary workmen.

The five terms' work embraces a progressive study of German, Mathematics, Physics, Electro-technics, Mechanics, Strength of Materials, Mechanical Engineering, Freehand Drawing, Descriptive Geometry, Chemistry, Hydraulics, Graphostatics, Building Construction, Book-keeping, French and English. In the fourth and fifth terms laboratory work occupies the great portion of the time.

I have taken the "Technikum" at Mittweida as illustrative of the curriculum in electrical engineering and the requirements and methods adopted, and it behoves us to consider in what respects these are inferior or superior to those adopted in our own technical institutions.

On comparing the curriculum with the courses at such places as the Central Technical College, the Finsbury Technical College, the Manchester Technical School, and other such institutions, I find but little difference except that in Germany they include what may be described as commercial subjects—book-keeping, English, French, &c.,—whereas we content ourselves with the technicalities of the subject. Technicalities are unproductive unless they are commercially applied, and I regard the Germany system as superior to our own in this respect.

On the whole, I think that, as regards the technical instruction in our institutions, it is more likely to result in a good comprehension of the subject, since while not neglecting theory, we pay more attention throughout the whole course to laboratory work. On the other hand, our German friends have the great advantage of compulsory experience in works ere they can obtain a certificate of proficiency. This is a point of extreme importance, and one to which I have on many previous occasions drawn attention.

Further, the requirements of the German institutions from students on entrance are more rigorous than our own. With the exception of, perhaps, two of our leading colleges, the requirements both as regard attainments and age on entrance are ludicrous.

What can we expect if boys—children—of 13 or 14 years of age are admitted to a three years' course, which is supposed to be sufficiently comprehensive to embrace even the groundwork of theory only? If boys of such tender years are admitted, their course is over before they can lisp science, let alone talk it. They come out in scarcely an embryonic condition, and only produce disgust and distrust in the technical institution which has had the impudence to turn them out. The earliest age of entrance should not be less than 16 years—a year later would be better—for even then a youth's mind is only approaching the condition of receptive ability.

We English, however, complain that 16 and 3 make 19, which is too late for a youth to start the practical work at a nominal salary! It is not too late if the three years' course is so arranged as not to produce a dislike of practical work. If for each hour of theoretical instruction there are at least two hours of hard work in the mechanical and electrical laboratories, it will not take a bright youth long to become valuable to his employer after leaving college.

Another point in favour of the German system I would draw attention to, viz., the compulsory year in works. The human mind is very much like soil. Let it lie fallow, or change the produce for a time, and it will become fruitful again.

There is such a thing as mental elasticity and, from experience, I firmly believe that a year's rest in the midst of a theoretical training is a very good thing, especially if the attention is in the meantime drawn, in a sort of latent fashion, to the phenomena that the theory has to establish. Not only this, but an uninterrupted course of theory tends to dogmatise, so to speak, one's own ideas and to stultify originality. Interrupt the theoretical training by a period in which ample opportunity is given to quietly think over the actual phenomena and not only will the accepted theory, if accurate, be more easily understood, but originality will find its vent, and dogmatism will only prevail so long as it can be supported by unprejudiced common sense and cultivated reason.

Two slices of dry bread are very difficult to relish, but they become quite palatable, nay, enjoyable, if a nice piece of beef is placed between them.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Electricity in Mines.

The allusion in your columns to Mr. J. Tonge's recent paper before the Manchester Geological and Mining Society, expounding the excellent results got at his collieries with electrical coal-cutting machines, has called forth a dismal whine from an evidently less successful colliery official of a different order.

The present writer is associated with one of the largest manufacturers of coal-cutting machinery (and one alluded to in the aforesaid whine) and is in a fairly good position to know what is being done with these machines, and it is not a difficult matter to prove that such, now happily rare, failures are due, not to the machines, but to those in whose charge they are placed.

With regard to the Jeffrey heading machine alluded to, there are hundreds of these at work both in this country and abroad, besides the still larger number used in its mother country, the United States, and its great utility and economy over hand labour can be vouched for by hundreds of colliery managers. The paper read only last Saturday at Sheffield by Mr. P. Greaves, before the Midland Institution of Mining, Civil and Mechanical Engineers, on the results at his collieries with the Jeffrey electric header, shows fairly conclusively that with the necessary human energy and skill, a great deal *can* be done with the machine.

As regards the Diamond Longwall coal-cutter, of which over 300 are in use, this machine was not *designed* in the usual sense of the word. It is the outcome of over 9 years' experience in one of the largest West Riding Collieries by the actual users, a colliery which last year raised 573,000 tons of coal, of which 454,000 tons were got by Diamond machines. This sounds very much like a machine "designed by a man who never saw a colliery." There are many other large collieries using in some cases as many as 20 Diamond machines, getting from these machines a large percentage of their total output at a reduced getting price, with far greater comfort and safety to the men and at increased saleable value.

What a shocking waste of time, &c., for two fitters to

require seven hours to accomplish what an ordinary screw withdrawer (purchased for 5s.) will do far better, and without injury to the shaft, in a few minutes!

The proper way to withdraw any coal-cutter armature is through the end, and with very little experience and the necessary apparatus, this is easily done. The writer knows of one colliery, where a large number of machines are used, where the armatures are taken out regularly every week end for examination and cleaning, and put back without the least trouble. There is very seldom height at the coal face to lift an armature from its case vertically, and the split shell has in the majority of cases long ago been discarded.

There is undoubtedly a splendid field for electricity in our mines, and there are many electrical machines for the purpose which are doing splendid work in the hands of painstaking and skilful officials. They are, however, no doubt capable of improvement, and, speaking for the majority of makers, there are immense efforts being made in this direction.

Your recent correspondent would do well to enlarge his colliery experience by visits to other pits, where the difficulties he appears to think so fearsome have been overcome, and the writer will be glad at any time to afford him the opportunity.

G. W. Bousfield, A.M.I.E.E.

Wolverhampton Tramways.

In reading over your remarks on my letter of the 25th ult., I notice "our correspondent has not studied our article," &c.

I beg to contradict that. You are charging the Lorain Co.'s renewals on the total working expenses, which is not fair, for, if a firm made a contract to put a plant up and then put it into thorough running order, I don't think that you would allow them to charge for the expenses incurred in putting it so, would you?

As for the expenses being greater for a full year's working, I don't follow that, as, the longer the tramways are being worked, the more experience is gained of its bad points, which can then be remedied (or partly so).

You seem to have misunderstood me in regard to the heavy run. I mean that the gradients are very heavy, *not* that the traffic is so.

With regard to live studs, I may say that the only accident that I can get to know of in two years is that of a horse receiving a shock.

Now, a word or two about the trolley system. *Why* did the Board of Trade make so many suggestions appertaining to the overhead wires and gear if they seem to be so reliable?

Again, we have only to read a few lines from your last week's article on this subject, and if we happen to be the engineer of a system, doesn't it throw (or seem to) more responsibility on our shoulders?

Take these lines: "The consequences of an accident of this kind (breakage of overhead wire) may be so appalling, that it is of the last importance that the wires themselves, and the supports which hold them above the rails, should be made a subject of constant inspection."

If it were not for first cost, most new tramways that are being laid now would have been of the surface contact type, but we shall gradually see them working their way in and ousting the trolley systems.

Norman Hope.

Explosions of Enclosed Arc Lamps.

Our attention has been called to the reputed explosions of enclosed arc lamps and the conditions under which such are possible.

In the first place, we should like to put on record that the lamps in question were not of Jandus make, and the fact that there are more than 27,000 Jandus lamps burning daily in this country, without a single explosion having been reported to us, is, we think, proof that the user of the original enclosed lamp has little to fear from this cause.

We made careful experiments in our test rooms some years ago, investigating fully the conditions tending to produce an explosion. We did not find that any mixture of carbon-monoxide and atmospheric air was explosive; but it is possible, with a certain form of enclosure *and* damp carbons to obtain conditions rendering this result possible. This is caused by the moisture being dissociated by the arc into free hydrogen, and in combination with the carbon, carbon monoxide. This free hydrogen will also produce flickering of the arc.

A simple and certain remedy is to keep the carbons dry.

The Jandus Arc Lamp and Electric Co., Ltd.
Adrian D. Jones, *Works Manager.*

Holloway, N.,
February 3rd, 1904.

McMillan Memorial Fund.

Having just returned from abroad, I was deeply shocked when I heard for the first time, on Friday last, of the death of the Secretary of the Institution, Mr. McMillan. All who had the privilege of knowing him will agree with me that he was one who never considered any amount of time or labour too much for any work he had to do for the Institution, either as secretary, adviser, or friend. He was always working for others and left no time to consider himself, and he often overtaxed his somewhat delicate constitution in consequence. From inquiry, I learn that he has been unable to make much provision for his wife and young family, and I would venture to ask, through the medium of the Electrical Press, that a McMillan Memorial Fund be opened, and that each of the leading Electrical journals should provide a column for subscribers, so that the many members, associates and students of the Institution may have an opportunity of contributing, and as these things are twice done if done quickly, the lists should be kept open for a limited time, say, one month only. Possibly similar proposals have already been made in other quarters, but in any event, I am sure it has only to be known to the 5,000 members of the Electrical Institution that funds are required, to meet with a hearty response from all. I remember well when our former respected secretary, Mr. Frank Webb retired, that on that occasion I acted as Honorary Treasurer in connection with a fund raised in recognition of Mr. Webb's valued past services to the Institution. The response was hearty and unanimous, and we are all pleased to know what a comfort and reward that contribution has been to Mr. Webb, and now with our younger dear dead friend, Mr. McMillan, we can only get the indirect consciousness to ourselves that we have done a kind action to one who can alas, now never thank us, but it rests with us to see that suitable provision is made for his children. I shall be glad to volunteer my services in connection with a small, special committee of gentlemen to help the matter forward, and have pleasure in subscribing one guinea to each paper opening its columns for subscription. Trusting that you will see your way to help in this matter, and thanking you in anticipation.

Henry Edmunds.

Upper Tulse Hill, S.W.,
February 7th, 1904.

[This matter is referred to in our leading columns.—Eds. E.R.]

Electrical Rock Drills.

Some time ago one or two articles appeared upon this subject, and it was observed by one of your correspondents that this field appeared to have been left to enterprise other than British.

This branch of the ever-widening electrical industry has not been entirely forgotten, and the writer would now be glad to learn of a mine where there exists near the rock face a three-phase, 50-cycle, power supply, in order to approach the manager with the view of testing such a machine in hard ground under normal conditions.

A. H. Gibson.

The Bristol Fire and its Lessons.

In Mr. Leonard Andrews's letter of February 6th, he says that an alternator losing its field becomes a short circuit across the bus-bars, and the switchboard attendant will have some difficulty in localising the trouble.

If an alternator loses its excitation, surely the operator can glance at the ammeter in the exciting circuit, and pull

out the main switch on seeing the exciter ammeter back at zero. I believe an ammeter in the field circuit is always provided; any way, they are on Ferranti switchboards. I have known this done on two occasions, both through a fractured wire in rheostat of shunt of exciter.

Of course, it largely depends on the operator, and the very low salaries that are often paid in the provinces do not tend to the safety of electrical undertakings.

Phœnix.

[Ammeters in the field circuit are not invariably provided. —Eds. E.R.]

Your correspondent, Mr. King, recently called attention to the importance of saving every second of time in shutting down plant in an emergency. Not only is this the case in light and power stations, where circumstances may demand such immediate action, but in large manufacturing works where power is transmitted over large areas by belting from one or more engine rooms, necessity may at any time arise in a distant department for the instant stoppage of that portion of the machinery. In this instance, such an apparatus as that described by your correspondent is a necessity for more reasons than one, and in some large works with which I am acquainted, the usefulness of the installation of such an automatic gear for closing the stop valve, which has now been in operation some years, has been over and over again demonstrated. Not only has it once prevented the racing of the engine, when the governor strap accidentally broke, by the sudden increase of the speed of the little centrifugal governor driven by the engine shaft automatically closing a contact and immediately releasing the catch holding open the valve, but instances have occurred when serious accidents have been timely avoided by the closing of the circuit by means of the push buttons placed in various parts of the works. The latter are so arranged that the mere breaking of the covering glass brings about the closing of the circuit.

After all, useful as such an installation undoubtedly is, it does not, for absolute safety to the large number of workers employed, appeal, I know, so directly to a responsible electrical engineer as a carefully devised scheme of distribution of electrical power to individual machines, or groups of machines, driven from a single line of shafting. No one knows so well as he that for simplicity, for absolute immunity from danger, which in a large works has to be so carefully fostered, and for the confining of any breakdown or stoppage to the department affected, a system of distribution by electrical power is equalled by no other.

Wm. Phillips Mendham,
Consulting Electrical Engineer.

Bristol, *February 8th*, 1904.

Municipal Appointments.

Can any of your readers give an explanation of the fact that an engineer employed by a company seldom, if ever, obtains any of the appointments advertised from time to time by corporations and councils, especially as regards the more advanced positions. I know of several fully qualified engineers who, being employed by large supply companies, have repeatedly applied for quite subordinate positions with councils, the result being the same in all cases, viz., a man from a small provincial station owned by a municipality gets the preference, although he may have had far less experience than other competitors, who are generally disqualified by the fact that they have gained their experience while employed by companies. Does some secret understanding exist among municipalities throughout the country to debar any but those men who have been trained to municipal dodges from obtaining a position with any of them?

That this state of things should exist, as it undoubtedly does, seems to be unjust in every way, and one can hardly help thinking that the municipalities themselves must be great losers by it, as in nearly all cases the company's man has had a much more severe struggle to gain the position he holds than the man holding a similar position with a council.

I should be glad to know if provincial men have the same difficulty that London men have in this respect.

C. F. B.

February 8th, 1904.

Faraday House Appointments.

My attention has been called to a letter, signed an "Old Faradian," which appeared in your last week's issue.

I should not have thought any reply necessary, but that the statements made are likely to mislead those unacquainted with the facts of the case. Of the students who completed the course during the period referred to, but a small proportion, less than half a dozen, went into central stations at all; again, of these, but a proportion started at the salary named.

I would suggest that in future, before you insert a letter calling in question the good faith of Faraday House, you give us the opportunity of publishing our statement of the case in the same issue.

H. Foulds, *Secretary.*
The Electrical Standardising, Testing and Training Institution.
(*Proprietors: The Syndicate of Electrical Engineers, Ltd.*)

Faraday House,
February 9th, 1904.

I observe in your issue of last Friday an insinuation that Faraday House is in the habit of sending its old pupils into central stations at any salary. I think it only fair to that Institution to say that, as far as I am concerned, they were the means of getting me a most satisfactory appointment with a large manufacturing company, and as I note the number of Faradians who are in these works, it would appear that there are very good grounds for doubting the accuracy of your correspondent's statement. I am not acquainted with the exact salaries paid to young central engineers, but it would appear that your correspondent, in his desire to injure his old Institution, considers no stick too dirty to beat a dog with; surely the fault, if any, lies with the engineers who offer such miserable salaries, and with them alone. Acquainted as I am with a large number of Faradians, I am thankful to know that the state of mind exhibited by the writer of the letter in question is conspicuously rare.

J. T. T.

As another Faradian, will you allow me to express my disgust at the preposterous remarks of your correspondent in last week's issue. My personal experience of Faraday House is directly contrary to the whole of his statements, for the secretary got me a fairly paid post before my time was up, and *not* in central station work.

The responsibility for the low salaries he complains of, surely lies on the shoulders of those offering them, and not on those who, from force of circumstances, are compelled to accept them. I deplore the intemperate tone of your correspondent's letter, which indicates a feeling I know to be singularly rare amongst my fellow Faradians.

T. C. H.

I read with regret the letter of an "Old Faradian" in your last week's issue, not only because my experience is entirely contrary to his statements, but also because I believe the ill-feeling he displays is exceptional. I can only say that when I told the secretary of Faraday House that I had been offered an opening at a trifling salary he advised me to refuse it, and shortly afterwards found me something considerably better.

Even if one or two cases were found to corroborate your correspondent's letter, these would in nowise justify his absurd conclusions.

Another Faradian.

It is evident from the tone of the letter bearing the signature "An Old Faradian," that the object of the writer is to injure the Electrical Standardising and Training Institution. My experience of Faraday House is, that it is extremely generous in dealing with its pupils. For reasons I need not enter into here, but connected with the recent disastrous war in South Africa, where my home is, the question of my third year's fee became a very serious one; judge, then, of my surprise and pleasure when the secretary refused my cheque for 100 guineas, and provided me with an opening, affording such experience as was an excellent substitute for

my third year. It certainly was not in an electric lighting station; but, although the pay is small, I do not consider myself "sweated," but, on the contrary, very fortunate in this matter, and naturally am grateful to Faraday House for its action. I presume your correspondent *is* an old Faradian, but I feel curious to know what he is like, as, from his letter, he appears to be rather a peculiar exception.

A. W. S.

February 8th, 1904.

As a Faradian, may I protest in your pages against the insinuations of a writer in your last week's issue who signs himself "An Old Faradian." I feel quite certain that Faraday House does not dump its students in the manner suggested. My experience is, that it not only exerts itself to provide its old pupils with posts at a reasonable rate of pay, but has their interests very much at heart. I was placed in a satisfactory appointment on my course expiring, and was, entirely through Faraday House, afforded the opportunity of transferring to a better one in about six months' time.

Again, so far as my experience goes, I have found Faradians far more inclined to stand out for higher pay than engineers trained elsewhere.

In conclusion, I cannot help expressing the conviction that the Faradian in question is happily a rare specimen.

J. W. G.

Perhaps the best answer to "An Old Faradian's" letter *re* the above is to quote the following paragraph from it, with the *vice versâ* in large type. "Nothing can keep a smart man in the background, however poor his training may be, and *vice versâ*."

That there is, and always will be, a small percentage of Faradians whom it is difficult to place is perfectly obvious, but to apply these isolated cases to Faradians in general, as "An Old Faradian" does, is a false statement of the case.

Moreover, such statements are liable to damage the interests of Faradians as a whole, as of course engineers and firms who employ Faradians will begin to inquire for men at the salaries of "10s. and 20s. per week" mentioned in "An Old Faradian's" letter.

He also goes on to say that "the youth trained in a provincial station for two years, starts on the same footing as Faradians." I very much doubt if "An Old Faradian" has met with such a case, and my own impression is that, a man so trained would be offered by the majority of station engineers a "volt boy's" job.

Ignoring the more hysterical parts of "An Old Faradian's" letter, what appears to me to be the worst feature of the letter, in question is the determined way in which the blame for these "enormous salaries" is laid on Faraday House. "An Old Faradian" agrees that the training given is a good one, therefore the blame, if any, would appear to me to lie with either the students themselves, or the engineers who employ them.

It is obvious that the salaries commanded by Faradians, will be regulated by the personal opinions of their employers with regard to their capabilities, and not by anything Faraday House can do, beyond training its students in the best manner possible.

In conclusion, I should like to suggest to "An Old Faradian" that, if he has a real cause for grievance, it would be far preferable for him to give particulars as to his name and the station in question, and not make such ridiculous statements as "80 per cent. of the students have appointments found for them at the enormous salaries of from 10s. to 20s. per week."

P. Vassar Hunter,
"*Faradian.*"

February 8th, 1904.

I read with interest the letter of "Old Faradian" in your last week's issue, and would like to make a few remarks on same. Is he not aware that the electrical engineering profession is overcrowded, and that every second young man one meets is going in for it, and that the supply of qualified electrical engineers far exceeds the demand. Then again, he seems to think that Faraday House men should be greatly sought after, and be paid large salaries, and be given good posts in central stations.

I beg to state, that for the post of shift engineer in a large station these highly-trained men are *not* required. No doubt they get practical work perhaps as gentlemen apprentices, or as switchboard attendants at a salary of nothing per week, the chief getting a good premium for teaching them (?) central station work. They get, no doubt, a first-class training in theory and electrical testing, but is this required for shift work? I say no, the men required are those who have served a full apprenticeship to mechanical engineering, served in pattern, engine fitting shops and drawing office, and afterwards going into some electrical works for a year or two and studying the theory at evening classes, and in spare time, and then after this going in for station work. Make a Faraday House man a charge engineer, and what is the result; he gets sick of the monotonous shift work in no time, and thinks of his great training, and says he ought to be chief right away. But "Old Faradian" need not despair, let him try and get into a station where the chief is also an old Faradian—no matter how many applied for the job, if he was the only Faraday man he would be selected for the post. But after all, a post in a central station is no catch whatever, especially as shift engineer. The work is the most thankless, monotonous, &c., under the sun; the hours are variable, and the atmosphere in most stations very unhealthy, and yet thousands of young men are willing to work for nothing, if they can only get into the coveted Municipal station. In conclusion, parents would do well to think twice before putting their sons in for electrical work, as unless they are geniuses, or have *great* personal influence and money they cannot hope to get on. The splendid training one gets at Faraday House fits one for designing electrical machinery and consulting work, and all the highest branches of the profession, and no young man with such a training, and with any spirit, would think of going into a central station, at any rate, as shift engineer.

R. W. R.

With reference to the letter under the above heading in your last week's issue, will you allow us to protest against both its statements and its conclusions? We feel convinced that, if not deliberately misleading, it is a gross and wilful exaggeration; and, moreover, it is not at all calculated to remedy the evil of which the writer complains.

Why does not "Old Faradian," if he is a Faradian, give the facts?

A statement that a man only gets 10s. to 20s. a week must be compared with all the other circumstances of his individual case. We know of cases in which students have preferred to go to a certain station of their own choosing when there was only the one opening at the above-stated salary in preference to other posts at 30s. to 40s. Similar cases occur in which the higher salary does not nearly recompense the advantage of living at home. These are not isolated cases we know, and if a man is getting a low wage, in most cases he has other advantages.

Knowing that "Old Faradian's" statements are based upon such cases as these, we desire in fairness to the Faraday House authorities, also chief and superintending engineers who have drawn from fellow students and ourselves, to show that "Old Faradian" has failed in his attempt to prove even a similitude to any such odious a system as "sweating" in the language of Hebrew tailors.

Four Faradians.

February 9th, 1904.

THE ACTION OF LIGHT ON THE RAPIDITY OF FORMATION IN ACCUMULATORS.

By D. TOMMASI.

I had for some time noticed this singular fact, that, in an accumulator, the negative plate which is exposed to the light will form more rapidly than those in the shade,* and this reducing action of the light is manifested irrespective of the active matter contained

* In all types of accumulators, the two extreme plates are invariably negatives.

in the plates of the accumulator, the density of the sulphuric acid used as the electrolyte, or the temperature of working.

In order to establish in a more precise manner the part which light plays in the formation, or, more accurately speaking, the reduction of the spongy lead, the active matter in the negative plates, I have carried out the following experiments:—

Two accumulators of my design,* each composed of a glass vessel filled with acidulated water, containing three negative plates and two positives, were placed: one, A, so that it was exposed to the rays of the sun, the other, B, in a cardboard box covered with pitch, and closed in such a manner as to completely exclude the accumulator from the light. The two accumulators were connected in series and charged with a current of from 2 to 3 amperes.†

During the first 30 hours no appreciable difference can be perceived between the negative plates of the accumulators, A and B; but after this period it is soon evident that the negatives exposed to the light begin to take a greyer appearance, showing that they are more advanced than the negatives which are in the dark.

This difference of shade, which is due to the greater or less quantities of lead oxide reduced, becomes marked at first, then diminishes, and finally disappears when the negatives are almost completely formed, that is to say, are reduced to spongy lead.

From these experiments, which I repeated a number of times,‡ it appears that *the negatives of an accumulator form more rapidly in the light than in the dark, other things being equal.* This fact having been ascertained, it was of interest to see whether light had any effect on the rapidity of formation of the positive plates.

With this view, I arranged two of my accumulators § in such a manner that the extreme plates were positives, each cell containing two negatives and three positives, as before.

One accumulator, A_1, was exposed to the light, the other, B_1, being placed in the dark. They were connected in series, and charged with a current of from 2 to 3 amperes. After about 20 hours it was possible to see that the positives placed in the dark had already acquired a darker colour; that is, they were oxidised to a greater extent than the positives exposed to the light. This difference is very noticeable at first, growing, then diminishing, and at last being practically inappreciable, when the positives are almost completely formed; that is to say, converted into lead peroxide. From this result it appears that *the positives of an accumulator form more quickly in the dark than when exposed to the light, other things being equal.*

Also, the positives formed in the dark are characterised by a dark brown appearance, those formed in the light being of a reddish brown. This difference of shades persists during several charges, but eventually disappears entirely. Thus the reddish colour of the positives which have been exposed to the light becomes darker and darker, until it attains the brown tint of the positives which have been formed in the dark.

One also notices that the negatives formed in the light have a lighter tint than those formed in the dark, but this difference is not very perceptible.

The capacity of an accumulator, whether charged in the light or in the dark, was found to be practically unchanged.

* See *Comptes Rendus de l'Académie des Sciences*, of December 29th, 1902, page 1,328, and Elec. Rev., January 2, 1903, page 7.

† The weight of the plates of each accumulator was 2 kgs., and their area 3·9 sq. dcm.

‡ These experiments, 18 in number, were carried out during the months of June, July, August and September.

§ These accumulators were exactly similar to A and B as regards weight and area of the electrodes, active matter, and density of the acid.

LEGAL.

Colwell and Others *v.* St. Pancras Borough Council.

This case came before Mr. Justice Joyce, in the Chancery Division on Wednesday and Thursday last week. Mr. Hughes, K.C., and Mr. Beaumont, appeared for the plaintiffs; and Mr. Bousfield, Mr. Younger, K.C., and Mr. Martin for the defendants.

Mr. Hughes, in opening the plaintiffs' case, said that plaintiffs sought to restrain a nuisance alleged to be caused to the plaintiffs by the defendants in the working and use of an electric generating station and dust destructor at Camden Town. The main point of the nuisance was the vibration. There was also nuisance from the noise of the engines, and from the dust and smell due to the use of the dust destructor.

His Lordship asked if the defendants had statutory power for the nuisance?

Mr. Hughes said they had not. The defendants were the undertakers for this purpose. The Borough Council undertook the lighting themselves, and the supply of electrical power in St. Pancras. There was a street called Great College Street, and at right angles to it Georgiana Street and Platt Street, and on the other side there was a road called King's Road. Plaintiffs had five houses in Great College Street. The plaintiffs were the leaseholders and occupiers, the defendants being the freeholders. They had purchased the freeholds.

His Lordship: I suppose you are asking too much all this time?

Mr. Hughes: I do not know that we have asked any price.

Mr. Bousfield: We have communicated with the other side through the solicitors, and the solicitors on the other side replied that their client was not disposed to sell, so there was no chance of doing anything.

Mr. Hughes replied that it was not material. The defendants had bought up the various interests of the other houses running along Great College Street. The defendants' scheme was not an electrical generating station worked in conjunction with a dust destructor, but there was one shaft between the two and that was common to both. He did not think that the two undertakings were worked together except to that extent. The station had been in operation for some years—or at least a certain part of it had. In May, 1902, having found it necessary to very much increase their power, defendants determined to carry out a very great increase in the plant—three large engines of 750 I.H.P. The engines driving the continuous current dynamo did not run in step, although they had them running, it might be, at only slightly different speeds. But they could run at different speeds, and consequently they did not thrust always at the same time. What happened was that they got a certain periodic increase and decrease in the vibration. In May, 1902, the defendants began working, but not at full load. At this time the plaintiffs occupying these houses began to find at various times a very great increase in the vibration, and complaints began which ultimately culminated in the action. The defendants asked at various times for some time in order to get the thing into working order, but ultimately this action was brought. The defendants in their defence said that the engines were at present defective in balance, and consequently did not run smoothly, but that this defect could be remedied if time were given for that purpose.

Evidence was given on behalf of the plaintiffs by Col. R. E. B. Crompton, C.B. He said he was instructed last October in connection with this case, and made an examination and inspection of the premises for the purpose of this action early in January. On Friday, January 8th, which was, he supposed, the time of maximum load, he went into No. 110, Great College Street. He noticed distinct vibration, which undoubtedly was caused by reciprocating machinery. It had a distinct beat which was easily recognised. He also went into Nos. 108 and 112. He noticed vibration there. He afterwards went to the generating station and asked that the engine might be shut down. This was done, and it had a remarkable effect. It reduced the amount of vibration that was observable in the premises to an extent that nobody could possibly doubt or deny.

Cross-examined: There were many rooms where there was no perceptible vibration. The houses in Great College Street were lightish buildings, and a bit loose jointed. The district was one where the traffic was heavy, but there was no trace of vibration set up by the passing of tramcars or wagons.

Mr. J. J. Bourne, A.M.I.C.E., corroborated the evidence of the last witness.

Mr. G. W. Colwell, one of the plaintiffs and the leaseholder of No. 110, Great College Street, gave evidence of the vibration being a serious nuisance. The destructor was also a nuisance, causing dust, smoke and smell.

Evidence as to the nuisance was also given by Mr. Malcolm Wheeler, M.R.C.S., in practice at No. 59, Great College Street, Mr. A. Baldwin, F.R.C.S., of No. 6, Manchester Square; Mr. Edmund Evans, a surveyor; Mr. G. West, a railway clerk; Mr. A. E. Pritchard, a musical entertainer; and by several other residents in the neighbourhood.

At the close of the plaintiffs' case, Mr. Beaumont, in dealing with the evidence given on behalf of the plaintiffs, said, with regard to vibration and the lapse of time which took place before the action was commenced, that the nuisance which was caused before the defendants put in their heavy machinery was very slight. The real nuisance occurred when the heavy machinery was put in. He did not for one moment suggest that the defendants had not tried to minimise the nuisance, but they had not succeeded in the least degree when the action was commenced. The defendants had not succeeded in doing so at the present time, but it was certainly less than it formerly was. There was no prescriptive right to commit a nuisance, and the defendants did not allege that they had been carrying on their works for 20 years. There was no evidence that the plaintiffs had been guilty of *lâches* or negligence in not complaining to the defendants of the nuisance; plaintiffs had done so. He (counsel), without binding himself, said he felt that if the defendants removed the new engines put in, the plaintiffs would not have much cause to complain. The noise was bad, but it was not so bad as the vibration, because that was constant, and at night it was very bad, because it affected the nerves of the inhabitants. He did not know how that could be cured. The nuisance from dust was also considerable, especially when there was a wind, when the carts were being unloaded, and when the clinkers were being brought out from the dust destructor. There was also evidence of a nuisance from smell, which was highly objectionable.

In answer to his Lordship, Mr. Beaumont said that the injunction he asked for against the defendants, was to restrain their servants and agents from working their electric generating station and dust destructor so as to cause a nuisance or injury to the occupiers of the plaintiffs' houses by vibration, noise, dust, and offensive fumes and smells, and so as to injure the structure of the said houses.

His Lordship said he did not see what right the reversioners had to sue at all, except for damage to the fabric.

Mr. Beaumont said that it was put in the statement of claim that vibration would cause injury to the structure.

Mr. Bousfield then proceeded to open the defendants' case. He said that there were two or three separate causes of action, or alleged causes of action. As to the minor matter of the dust destructor, he wished to say that the defendants had no wish to annoy the inhabitants of the district. It was not only the

defendants' duty, but their desire to do everything they could which would conduce to the sanitary and salubrious character of the neighbourhood. Mr. Blair, who was the defendants' engineer who had to do with the dust destructor, would tell his Lordship that ever since 1895 they had been improving their arrangements. There was really nothing which any reasonable person could complain of. The fact was that the dust destructor was better than it ever was before. He would not trouble to put the case higher than that. Then as to the electric lighting plant, it might be of importance to him to establish that as regarded the old plant there was nothing of which any reasonable person could complain. They had forgotten the fact that the old plant was at work in 1895, and had been working ever since. It was an extremely strong observation to make with regard to the old plant, to say that nobody ever really complained about it. He would now come to the time when the three new engines were installed. As to those he would make an admission. He did not think he ought to contest that there was an amount of vibration at times between May and December which a reasonable person had the right to complain, of if the vibration had been of anything more than a temporary character. He was not going to say that the occasions as to which several people had spoken in their evidence as being a nuisance would not have been a nuisance if it had been permanent. But what he should submit about that was that a public body doing its best to discharge its statutory duty with reasonable skill was entitled to a certain amount of grace, and if notwithstanding the amount of skill and experience the body could bring to bear upon it there was a temporary nuisance, it was not a case for an injunction. That was the state of things before the writ was issued. He submitted that on and from January 8th there was nothing which any reasonable person could complain about—there was one exception, and that was with regard to Mr. Colwell and his daughter's bedroom. It was suggested and the defendants thought that the vibration arose owing to the nature of the foundations, or at any rate local peculiarities. As soon as it was suggested, defendants set to work to balance the engines much more closely, and that work had been going on ever since. The great authority on this point as to the balancing of engines was Prof. Dalby, and defendants had put themselves in his hands. Defendants thought, and had every reason to hope, that everything would be remedied if the engineers had time in which to complete their experiments. The learned counsel submitted that the defendants were under a statutory duty to supply the district with electricity. Defendants' duty was to use all reasonable skill and care to carry out their statutory obligations without committing a nuisance, even of a temporary character. It could not be put higher than that a public body had the same protection as a private individual had.

His Lordship: You say the limit of your duty is to use all reasonable precautions against causing a nuisance.

Mr. Hughes: Yes.

The learned counsel cited certain cases in support of his contention.

On Friday, Major P. Cardew, examined by Mr. Bousfield, said he had attended at the defendants' station with reference to the complaints at various times when the electric light plant was running. He first visited the premises on January 8th. He got there shortly after five o'clock. He found two alternators and some of the old plant, which were synchronised while he was there. There was no difficulty in synchronising the engines so that they ran to balance one another. From what he saw there was very little vibration. The engines were running quietly, but there was a slight noise from the escape of steam. He went to No. 108, Great College Street, and found a certain amount of vibration there in the drawing room. He noticed it by watching the images on the piano, and could see that the leaves of the artificial flowers moved slightly. He could not feel anything while sitting in a chair in the room. He did not notice anything in the other rooms of the house. He went into No. 112, but could not detect any vibration there. He also went into No. 116, and there he noticed slight vibration in a bedroom on the second floor. It was necessary to concentrate your attention on it to discover that there was vibration. On January 11th defendants had more plant running—two alternators and six small sets. The load was not very large at that time, but the machinery was running at full speed. He went again into No. 108, and there the vibration seemed less distinct on that occasion. He went again into No. 112, and he noticed a very slight vibration in a sitting-room there. He went also into No. 114, and there a slight vibration could be observed. At No. 116 he went into the same bedroom again, and there there was less vibration. At these tests practically everybody was present at the same time. The houses were not of very solid construction; the floors shook a little as you moved over them.

The Witness spoke as to other experiments he had made, and said that such vibration as there was proceeded from the new machinery. In his view, excepting in the room where the piano was and in one of the bedrooms, there was no vibration of which any reasonable person could complain. He had been told what had been done by the defendants up to the present, and, in his view, those who were responsible for the undertaking had done and were doing all that reasonable skill could do to remedy the vibration. He had no doubt that the engines would ultimately be brought into perfect balance. He quite agreed with what Prof. Dalby was doing in the matter. He thought the vibration would be perfectly cured.

Cross-examined by Mr. Hughes: It was difficult to say what effect vibration might have on different organisations. He thought the vibration was caused through defective balancing of the engines.

Re-examined: He had no doubt that the mathematical balancing of the engines would be a perfect cure for the vibration.

Prof. Dalby, examined by Mr. Bousfield, said that he had devoted particular attention to the subject of the balancing of engines. That subject frequently arose in the case of torpedo boats. He had seen the defendants' engines. They were of the type usually used in central station work. In these engines there was a very considerable amount of balancing got by the disposition of the cranks and the moving parts. There was still, however, an unbalanced residue. Experience showed that such engines showed no vibration in certain conditions. It was necessary to get rid of the unbalanced residue. He proposed to do this by adding balancing weights on the machinery. He had had experience in the past of this sort of thing, and he had not the slightest doubt that he would cure the vibration in this case. The Witness said that he had paid visits to the plaintiffs' houses in company with the last witness, and corroborated the evidence he had given.

Cross-examined: There was no reason for there to be any vibration on a torpedo boat if the engines were perfectly balanced. The necessary work in the present case would take some months. He was not aware that at Manchester they had to give up reciprocating engines and have turbines.

Evidence was then given by Mr. Blair, defendants' engineer, on the issue as to the alleged nuisance from the dust destructor.

On Monday Mr. Justice Joyce delivered judgment. He said this action was instituted on November 30th, 1903, and it was virtually admitted before him—and, in truth, it could not be denied—that by reason of the vibration caused by the defendants' works at various times, and from time to time between the months of May and December, the plaintiffs had a right to complain of the annoyance to which they had been subjected, or, rather, a right to complain unless it were merely a temporary annoyance, and it was such an annoyance as, if continued, the defendants could not deny to be a nuisance in law. That, he said, was virtually admitted, but at all events, if necessary, he decided on the facts that that was so. In other words, it appeared to him that, by the vibration caused by the defendants' works and machinery, so much nuisance had been occasioned by the defendants as to justify the action, unless the defendants could show that they were entitled to cause a nuisance by reason of its being, as they alleged, a temporary nuisance, or by reason of something in the nature of the annoyances referred to. He was of opinion that the amount of the annoyance caused had been a material interference with the comfort of the plaintiffs. In this particular case, the annoyance caused had not been temporary and occasional personal inconvenience, but, in his opinion, was such as was calculated to work material injury to the property of the plaintiffs, and, beyond all question, was most serious and likely to depreciate the value of the plaintiffs' property. In this particular case there was a clause in the order which authorised the work, that nothing in the order should exonerate the undertakers from any indictment or other proceedings for nuisance in the event of any nuisance being occasioned by them. What it really came to was this, that notwithstanding that order it was suggested that for months or it might be for years after the first erection or construction of the works the defendants were entitled to make the neighbourhood uninhabitable or to cause annoyance and vibration until the time might have arrived when they should have contrived or managed in some way or other to carry on their works without creating a nuisance. What was to happen if they never succeeded in doing that, no one was told. However, that proposition to him was entirely wrong, and was one to which he was quite unable to accede. He would rather say that after the construction of their works, if not before, the owners of these works, particularly under an order like this, were not entitled to carry them on at all unless and until they could do so without occasioning a nuisance to the neighbouring owners of property. In his opinion there must be an injunction, not distinguishing in any way between the old machinery and the new, restraining the defendants from carrying on these works in such a way as by vibration, noise, or otherwise to occasion a nuisance or injury to the plaintiffs during the continuance of their lease, and there must be an inquiry as to damages. This order would be without prejudice to any question in reference to any nuisance or annoyance that might be caused by the working of the dust destructor after March 30th next, and the defendants must pay the costs of the action.

Mr. Younger asked that the injunction might be suspended for six months.

Mr. Hughes thought three months, with liberty to appeal, was sufficient.

Mr. Justice Joyce suspended the operation of the injunction for six months, saying there was to be no nuisance and vibration between 12 p.m. and 7 a.m., and after May 1st between 11 p.m. and 7 a.m. The inquiry as to damages would be directed to the separate interests of the plaintiffs.

Gas *v.* Electricity.

Mr. Justice Swinfen Eady, in the Chancery Division on Saturday, had before him a petition by the Hessle (Yorks) Gas Light and Coke Co., Ltd., asking the sanction of the Court to certain alterations in the articles of association with a view to empowering them to supply electricity, chiefly for lighting purposes. Notice had been received and affidavits had been filed on behalf of the Hessle U.D.C., who claimed power to oppose the petition. Judging from the affidavits, said counsel, their desire appeared to be to save the company from itself. They seemed to be afraid that it would not be so successful as it had been in the past. Counsel proceeded to read the proposed amendments, which his Lordship said seemed to be a lot of

outrageous rigmarole. It exceeded anything he had ever seen before.

Mr. Eve: It is a Gas Co.

His Lordship said the petition must stand over, and gave leave to amend.

Street Obstructions.

In the King's Bench Division, before the Lord Chief Justice and Justices Wills and Kennedy, the liability or otherwise of workmen in the employ of the Post Office authorities to be proceeded against under the Metropolitan Police Act for causing two trucks to stand in Aldersgate Street "longer than was necessary for loading and unloading" came up for argument. A *rule nisi* had been obtained at the instance of the Postmaster-General during the vacation with the object of prohibiting summonses taken out against two men named Byott and Baily from being heard.

Mr. Danckwerts, K.C., who appeared to show cause against the rule, said the men were engaged in repairing an underground telegraph cable in Aldersgate Street, and had kept two trucks standing in the street for the greater part of the day.

The Solicitor-General replied that if this had been a proceeding instituted to raise the question whether the Postmaster-General or his employés had acted in excess of the powers given them by the Telegraph Act, he should not have offered any opposition; because, although the Telegraph Act gave a right to the Postmaster-General and his employés to commit what would otherwise be a public nuisance on the highways, yet it was quite plain that there must be no excess of obstruction. The present summonses, however, could not possibly raise that question. These men had not taken the trucks with them for the purpose of "loading or unloading them," as mentioned in the summonses, but only to carry their tools.

Their Lordships, however, were of opinion that upon the facts the cases must go back to be heard, the question of costs to be reserved.

Geipel's Steam Traps.

In the Court of Appeal, composed of Lords Justices Vaughan-Williams, Stirling and Cozens-Hardy, on Tuesday, judgment was delivered on the appeal of Wm. Geipel from an order of Mr. Justice Buckley, directing a patent, No. 7,860, granted to him in 1893, to be revoked unless certain disclaimers were made.

Lord Justice Stirling read the judgment of the Court. He said the appeal was from an order of Mr. Justice Buckley upon a petition for the revocation of a patent by which he directed that the patent should be revoked unless within three months or such further time as the Court should allow, the patentee should obtain leave to disclaim two figures in the complete specification. The present appeal related to only so much of the order as referred to one of them, the patentee admitting that as regarded the others the decision of the Court below was well founded. The ground upon which it was sought to revoke the patent was that there was disconformity between the provisional and complete specifications. The patent related to improvements in steam traps which were devices for discharging condensed water from steam pipes or other receptacles for steam. The valves were made so as to act automatically, as the water fell, it caused the metal to expand or contract by the variation of temperature, so that when water formed the valve opened. Before the date of the patent in question this had been accomplished in various ways. Their Lordships, in the result, held that there was no disconformity between the provisional and complete specifications, the figure in the complete specification being merely a development of a figure found in the provisional specification. The appeal was accordingly allowed.

Electric Tramways Construction and Maintenance Co., Ltd.

The petition of Alldays, Ltd., for the winding up of the Electric Tramways Construction and Maintenance Co., Ltd., was in the list for hearing before Mr. Justice Byrne on Tuesday last, but when it was called on, Counsel for the petitioners asked leave to withdraw it. He said that his clients had been substituted for other petitioners, and terms had been come to between them and the company.

Mr. Whinney appeared for creditors who supported the petition, and who had not been settled with, and he asked that they might be substituted as petitioners.

Mr. Justice Byrne thought Mr. Whinney's clients were entitled to an order, which he accordingly made, and gave leave to make the necessary amendments in the petition.

Moore *v.* The Lord Mayor, &c., of Manchester.

This case came on at the Manchester Assizes, before Mr. Justice Jelf, last week.

The plaintiff, on August 1st last, had occasion to go to Ashton, and travelled by electric car as far as Audenshaw, there changing into a horse car, by which the journey was continued. At the Ashton terminus she was descending the steps from the roof when the car, as alleged, moved forward; the sudden jerk caused her to slip, and her right leg was broken.

Several persons, called on behalf of the plaintiff, bore out her statement as to the car suddenly moving.

The suggestion of the defence was that the plaintiff, in descending the slippery steps of the car on a wet night, did not exercise due care, and that her injury resulted from an accident for which the Corporation were not responsible.

The Judge said if there was an involuntary movement of the horses it would be a question for the jury whether it was such as could have been avoided.

A number of witnesses, including the guard of the car, were called. The guard said the car was standing with the brake on, and it was impossible for it to be moved. Others stated that the car was stationary when the plaintiff fell. The driver said there was no movement whatever of the horses, and the brakes were full on.

The jury found a verdict for the plaintiff, damages £120.

Dixon *v.* The Lord Mayor, &c., of Manchester.

The plaintiff, in this case, heard at the Manchester Assizes, was a Miss Ruth Dixon, and she claimed damages from the defendants for injuries sustained by her through being knocked off her bicycle by an electric car in Chester Road, Hulme, on July 26th. The evidence was contradictory, and the testimony of one of the defendants' witnesses brought forth some severe comments from the Judge. During the course of his summing up, his Lordship (Mr. Justice Jelf) said that he had never heard a more truly scandalous suggestion than that the witness, an architect and surveyor, should give evidence in favour of the Corporation and against the young woman, not because it was the evidence of truth, but because it was evidence that would save the ratepayers' pockets.

The jury returned a verdict for the plaintiff, with damages £85.

Stocks *v.* The Corporation of Oldham.

This was a case also heard at Manchester, in which damages were alleged to have been caused by the electricity works of the Oldham Corporation. The Corporation had been advised that the claim should be disposed of by their paying a small sum towards the expenses of the plaintiff, it being understood that they admitted no liability, and paid no sum in respect of damages.

Mr. Langdon, who represented the plaintiff, concurred.

Mr. Justice Jelf assented, and the record was withdrawn.

Higgins *v.* The Mayor, &c, of Oldham.

Before Mr. Justice Bigham at Manchester, this action was brought by the plaintiff to recover damages from the defendants for injuries received through the negligence of their servants. The plaintiff, it appeared, was on July 25th last knocked down while crossing Ashton Road, Oldham, by one of the defendants' electrical tramcars. The plaintiff's left upper arm was fractured, and he was unable to follow his employment. The defendants pleaded that the accident was entirely due to the plaintiff's own carelessness.

The jury found a verdict for the defendants, but recommended them to take the case of the plaintiff into their favourable consideration.

The Corporation, however, while denying liability, had paid £75 into Court.

The Judge suggested that the Corporation should give to the plaintiff's wife the sum of £40, so that it might not be taken for legal expenses.

Mr. Rhodes, for the Corporation, asked for judgment without costs, which was granted, and later announced that the Corporation had consented to pay the plaintiff's wife £1 per week for 40 weeks.

Crowther *v.* Copinger.

In this case, heard last week at Manchester, the plaintiff, Edwin Philpott Crowther, an electrical engineer, of Manchester, sought to recover damages for libel from Charles A. Copinger, also an electrical engineer, carrying on business as Copinger and Co., in Manchester. Defendant had been apprenticed to the plaintiff, and remained in his employ until 1901. At the end of 1900 plaintiff's business (Crowther & Co.) was converted into a limited liability company as Crowther and Company's Electrical Industries, Ltd. Early in 1902 the concern went into liquidation, and the defendant purchased the stock and goodwill from the liquidator. The plaintiff since 1902 has acted as the manager of a business established by his wife, and also carried on under the style of Crowther & Co., electrical engineers. The libel complained of was contained in a letter which was written by the defendant to Mr. H. K. Kempton, of Buxton, who was a customer of the plaintiff's. In this letter it was stated that "Mr. Crowther, the managing director," had absconded when the Electrical Industries Co. went into liquidation, and also that the defendant, since taking over the business, had endeavoured "to carry it on on an honest basis." The plaintiff, in his evidence, emphatically denied that he had absconded or that he had conducted his business in a dishonest manner.

Cross-examined, the plaintiff admitted that when the prospectus of the new company was issued at the end of 1900 the business was described as "a sound and profitable" one, although there was no cash in hand and there was an overdraft at the bank. He also admitted that he had a short time before written to the Income Tax Commissioner to the effect that the business had been carried on at a dead loss, and that nevertheless he had issued advertisements stating that the profits of the company were estimated to produce "never less than 10 per cent.," and might possibly "reach 40 per cent."

The jury stopped the case, and judgment was entered for the defendant.

Harter *v.* Manchester Corporation.

In this case the Corporation applied for an extension of time in regard to an injunction obtained by plaintiff in respect of a nuisance caused by excessive vibration at Bloom Street Electricity Works. The application was granted, also a request that the trial should not come on until a week after the motion.

Ferranti, Ltd.

In the Chancery Division on Tuesday, Mr. Justice Byrne had before him the petition of Estler Bros., creditors, for the compulsory winding-up of Ferranti, Ltd., on the ground that the company was insolvent. A large body of debenture-holders opposed the petition.

Mr. Buckmaster, K.C., for the petitioners, said they were creditors for £827, partly for goods sold and delivered and partly in respect of dishonoured acceptances. The company was incorporated in July, 1901, with a capital of £400,000 in £1 shares, to acquire the business of another company called De Ferranti, and to carry on the business of electrical engineers. In December, 1901, the company had issued £100,000 first mortgage debentures, and on the terms of that issue hung a great deal of this matter. The company carried on business till December last, when receivers and managers carried on the business at the instance of the debenture-holders. When they entered on the business they prepared a circular and balance-sheet which showed £413,597 assets, and secured creditors £100,000. In these circumstances the petitioners could not get paid. The company had not filed any affidavit in answer to the petition, but the debenture-holders, through Messrs. Tate & Whittaker, the receivers and managers, had put in an affidavit in answer. The matter stood over from time to time, pending the settlement of a scheme, but nothing had come of it, and now it seemed that the directors had determined to effect a voluntary liquidation of the company.

The learned counsel said he objected to a voluntary liquidation, but the terms of the trust decided if there were a voluntary liquidation, the holders got a bonus of 10 per cent. on their debentures. If it were compulsory they would only get 5 per cent.

Mr. George Henderson, representing creditors for £14,000, supported the petition.

After hearing counsel for the company the petition was ordered to stand over.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Feb. 10th, 1903.		Week ending Feb. 9th, 1904.	
Adelaide. Teleg. mat...	Value £575	Adelaide	Value £60
Amsterdam	83	Alexandria	66
Auckland	10	Amsterdam	70
Bangkok	275	Antwerp. Elec. fuses	274
Bombay	22	Buenos Ayres	92
Bordeaux	125	Calcutta	836
Calcutta	8,507	Cape Town	181
Cape Town	90	Colombo	277
Channel Islands	45	,, Teleg. mat.	26
Colombo	69	Durban	1,491
Copenhagen. Teleg. wire ..	18	East London	420
Durban	390	Flushing	40
East London Teleg. apparatus	200	Gibraltar	64
Fremantle	21	Hobart. Teleph. cable	345
Ghent	80	Hong Kong	870
Gibraltar	33	Kobe	24
Hamburg	15	,, Elec. instruments ..	66
,, Teleg. cable ..	50	Madras	18
Hong Kong	20	Melbourne	28
Karachi	12	Mossel Bay	23
Lisbon	33	Otago	58
Madras	76	Paris	131
Melbourne	542	Perth	173
Ostend	250	Port Elizabeth	22
Otago	484	Rio Janeiro. Sub. teleg. cable	9,550
Perth	25	Rotterdam. Teleg. wire ..	15
Port Arthur	187	Shanghai	212
Port Elizabeth	104	Singapore	98
Port Said	40	Sydney	883
Shanghai	394	,, Teleph. cable	1,491
Sydney	168	Tientsin	859
Wellington	231	Valparaiso	11
Yokohama	39	Wellington	221
		,, Teleg. mat... ..	684
		Yokohama	135
Total ..	£8,163	Total ..	£19,314

Foreign Goods Transhipped.

Bordeaux. Elec. mat. ..	Value £125	Melbourne. Elec. appar.	Value £36
Sydney. Elec. goods	60		
Total	£185	Total	£36

Brush Car Contracts.—The Brush Electrical Engineering Co. have lately secured the following contracts:—

Ipawich (per British Westinghouse Co.), 10 car bodies and trucks (repeat order).

Manchester Corporation, 100 car bodies (repeat order).

Sunderland District Tramways Co. (per Bruce Peebles & Co.), 30 car bodies and trucks.

Gloucester Corporation, 10 car bodies and trucks (repeat order).

Correction.—On p. 171, in our reference to the bankruptcy proceedings of G. Neale, the Terminus Electrical Co. were referred to as creditors for £411, and Mr. S. R. Gardner for £68. We are asked to say that the Terminus Co. are creditors for £68 only, and Mr. Gardner for £411.

New Journal.—We have received a copy of the first number of the *South African Engineer* (British Edition). It is a 6d. monthly journal relating to mining, agricultural, electrical, mechanical, railway, sanitary, and, indeed, all branches of engineering. Several columns are devoted exclusively to electrical matters, but those who turn to these, expecting to find information respecting new steps which are being taken in South African towns in regard to electrical development schemes, will be disappointed; no doubt this will be remedied when the new journal becomes thoroughly established.

Tower Wagons.—Messrs. J. H. Heathman & Co., of Parson's Green, S.W., who are well known in connection with the manufacture of tower wagons, send us particulars of an improved wagon recently supplied to the Barking Tramways for the erection and repair of the overhead constructional work. Among other improved features the tower is set lower down than usual, giving a reduced height when closed. There is also an improved locking arrangement, which, by the movement of one lever, operates the locks at all four corners to secure the rising section, in the unforeseen event of a rope breaking; although, as there are four independent homogeneous steel wire ropes at the four corners, such a mishap is somewhat remote. The revolving platform can be locked by a screw in any position. The winding arrangements are operated at the back, so as to be quite clear of side traffic, and the hind axle

Improved Tower Wagon.

is made longer than usual with a view to increasing the stability of the vehicle. A large tool box is provided, and one man can raise and lower the sliding section when fully loaded. The vehicle is solidly constructed, and sufficiently light for one horse to draw. We are given to understand that Messrs. Heathman contemplate enlarging their works owing to the rapid increase in their business.

Parliamentary.—*North Yorkshire Dale Railway.*—On Thursday last week, promoters of this Bill should have come before the Examiner for proofs of compliance with standing orders, but as there was no appearance, the Bill was marked "Dead."

Petitions.—The Barking U.D.C. has deposited a petition in the Private Bill Office against the East London and Lower Thames Electric Power Bill; and the Willesden U.D.C. is petitioning against the Harrow Road and Paddington Tramways, and the London County Council Tramways Bill.

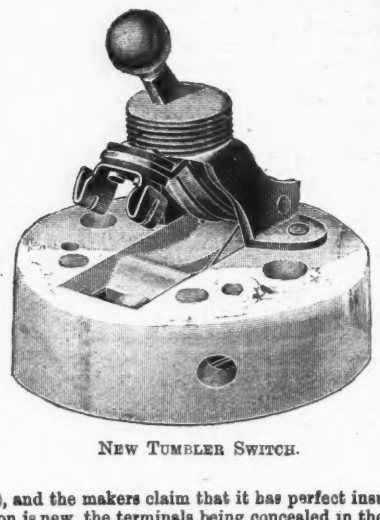
Amongst other petitions which have been deposited in the Private Bill Office of the House of Commons are the following:—By the Borough Councils of Stepney and Woolwich, and the Wanstead U.D.C. against the East London and Lower Thames Electric Power Bill; by Meux's Brewery Co. against the Charing Cross, Euston and Hampstead Railway; by the Wanstead U.D.C. and Mr. W. Blewitt against the Leyton U.D.C. (Tramways) Bill; by the Watford U.D.C. against the Watford and District Tramways (Extension of Time) Bill.

Standing Orders.—On Monday the Harrow Road and Paddington Tramways Bill, and the Torquay Tramways Bill, came before Mr. Campion, the Examiner, and Standing Orders were found to have been complied with.

Germany.—The Accumulatorenwerkegesellschaft, system Tribelhorn, is the name of a company which has just been formed at Eschweiler.

German Imports and Exports of Electrical Machinery.—There was a marked increase last year in the exports of electrical machinery from Germany, the return for the 11 months ending with November last showing a total of 12,276 tons, as compared with only 12,170 tons in the corresponding period of 1902. On the other hand, there was a falling off in the imports of foreign electrical machinery into Germany from 1,320 tons in the first 11 months of 1902 to only 805 tons in the 11 months ending with November last.

New Switch.—The accompanying illustration shows a new switch which is supplied by Messrs. Plutte, Scheele & Co., of Queenhithe, E.C. It is small and compact, and has a long break

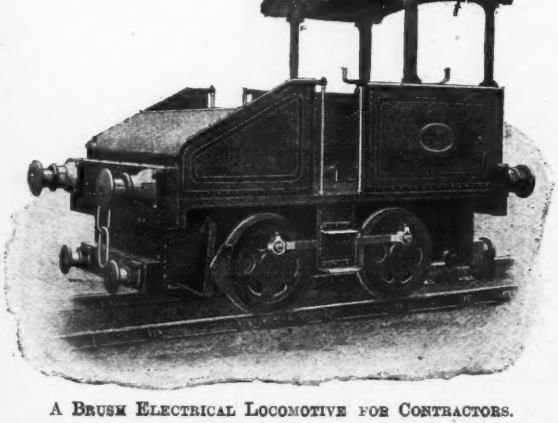


New Tumbler Switch.

($\frac{3}{4}$ in. full), and the makers claim that it has perfect insulation. Its construction is new, the terminals being concealed in the base. The roller of hard insulating material is claimed to ensure perfect insulation of the lever from all other brass parts.

Catalogues and Lists.—Messrs. Crompton & Co., Ltd., of Chelmsford, have brought out a new list giving descriptive particulars and tabulated figures as to prices, outputs, and efficiencies of their single-phase transformers of the core type for lighting and power circuits.

Bulletin No. 5, which has just been issued from the press by the Brush Electrical Engineering Co., Ltd., is devoted to their work in the direction of steam and electric locomotives. Only a small section is devoted to the latter class, the list being apparently intended chiefly for railway officials who are halting between two opinions in regard to the question of electrification, for during the years which will elapse pending electrification, the Brush Co. is



A Brush Electrical Locomotive for Contractors.

prepared to meet the requirements of steam locomotion, as it has been doing for years past. Our readers are, perhaps, given to regarding the Brush Co. as an electrical manufacturing company and nothing more, but a perusal of this catalogue shows that its numerous types of steam locomotives are running in many parts of the world. The illustrations show many types for light railway systems, and for contractors, mining and other similar work.

Mr. G. Braulik has issued the third edition of his catalogue and price list of "Eclipse" electricity meters.

Messrs. Geipel & Lange, of 72A, St. Thomas Street, S.E., have issued a new price circular of the Ward-Leonard motor starters.

Messrs. Joseph Kaye & Sons, Ltd., of Hunslet, Leeds, have issued a new illustrated price list for 1904, showing the latest improvements in their oil cans.

Trade Announcements.—The Reid Gear Co., of Linwood, near Paisley, have removed to new premises, which are said to be the largest in Scotland given over entirely to the production and cutting of gears. The works have a floor space of about 22,000 square feet, and are equipped with the most up-to-date machines for the production of machine-cut gears of all descriptions in quantities.

The Chloride Electrical Storage Co., Ltd., of Clifton Junction, near Manchester, has opened an office at 78, King Street, Manchester, to deal with business in the North. This office will be under the charge of Mr. Davenport, who has been for many years the Chloride Co.'s representative in the North.

On February 15th the Edison & Swan United Electric Light Co. will open a wholesale West-end warehouse and showrooms at 60, Great Marlborough Street, Regent Street, W., where large stocks of the "Royal Ediswan" lamps, and of their other manufactures generally, will be held for the convenience of the trade only. Showrooms will be fitted up there for electric light fittings.

Mr. H. Holt has resigned his position as the manager of the plant and motor department at Messrs. Veritys, Ltd., London, and has taken up a similar position with the Rhodes Electrical Manufacturing Co., at 70, Bishopsgate Street Within, London, E.C.

Mr. Henry W. Clothier, whose association with H.T. switchgear designs is well known, has resigned his position as manager of the estimating department of Messrs. Ferranti, Ltd., in order to take up the improvement and development of the business of Messrs. Walker & Hodgetts, Ltd., of Salford. Mr. Clothier joined Messrs. Ferranti, Ltd., when their works were situated at Charterhouse Square, London, in the year 1894, and has the record of having designed the first oil break switch that was put to commercial use in this country. He was chief assistant to Mr. Ferranti in the design of switchgears, &c., up to the end of 1900, when he was offered an appointment vacated by Mr. Morton Beales as commercial manager for the switch department. During the two years that he held this position, the business of the switch department met with great success. At the commencement of 1903 the management of Messrs. Ferranti, Ltd., was reorganised, and he was appointed to the position he has recently given up. Messrs. Walker & Hodgetts were initiated in the year 1898, and became a limited liability company in the year 1900. They are known as makers of dynamos and motors, their clientage hitherto being chiefly colliery companies, theatres, and other users of lighting and power installations. They have made a speciality of electrical haulage equipments and other electrical machinery for mines. Mr. Hodgetts will in future devote his attention to the management of the works, and to the design of motors and dynamos, in which class of work he has specialised for a number of years, some twelve or thirteen hundred machines having been built from his designs. It is now the intention of Messrs. Walker & Hodgetts to promote the interest of the existing motor and dynamo section, and to inaugurate a special department for the manufacture of switchgears for use in central stations, collieries, &c.

Messrs. Sybry, Searls & Co., Ltd., of Cannon Steel Works, Sheffield, have opened a London office at 46, Queen Victoria Street, E.C., for the supply of their tool and mining steels, crucible steel castings, rock drills, &c.

The Paterson Engineering Co., Ltd., of Norfolk Street, W.C., have opened an office at Amberley House, Norfolk Street, W.C., so as to be the better able to attend to business in the South of England.

Book Notices.—"Bulletin de l'Association des Ingénieurs Electriciens, Sortis de l'Institut Electrotechnique Montefiore." December, 1903. Paris: Gauthier-Villars. 7 fr.

"Atti della Associazione Electrotecnica Italiana." November—December, 1903. Rome: Tipografia dell Unione Co operattiva Editrice.

Journal of the Institution of Electrical Engineers. January, 1904. No. 164. London: E. & F. N. Spon, Ltd. 2s.

"Elements of Electro-magnetic Theory," by S. J. Barnett. London: Macmillan & Co., Ltd. 12s. 6d. net.

"Dynamo-Electric Machinery." Vol. I., Continuous Current Machines. Seventh Edition. By S. P. Thompson. 30s. net.

"Electrical Engineers' Pocket-book," by H. A. Foster. Third Edition. 21s. net.

"A Manual on the Care and Handling of Electric Plants," by N. H. Schneider. London: E. & F. N. Spon, Ltd. 3s. 6d. net.

"Quarterly Bulletin of the American Institute of Architects." July—October, 1903. London: William Wesley & Son.

Who's Who, 1904. London: A. & C. Black. Cloth, 7s. 6d. net. —Few words are required to review this work, for it is so widely known and used. It is a biographical annual, and, as has been aptly said, is of great value to those who want to know "anything about anybody" of note.

Who's Who Year-Book, 1904. London: A. & C. Black. 1s. net. —This book contains the tables which were formerly a popular feature of *Who's Who*. One can find out at once by reference to these tables the names of ambassadors, academicians, ecclesiastical dignitaries, clubs, colonies, members of the Government and the House of Commons, King's Counsel, newspapers and their editors, schools, railways, societies and their secretaries, and last, but not least, university professors. It is an invaluable work.

The Englishwoman's Year-Book. London: A. & C. Black. 2s. 6d. net.—This publication forms a useful collection of information respecting educational and charitable institutions, and much interesting matter is given respecting the work of women in medicine, science, art, literature, music, also relating to religious, political and other spheres in which the fair sex have special interest. There is placed here in very convenient form much matter that might be referred to many times in the course of the year, even by a mere man, but it is undoubtedly a book which our wives and sisters would study with interest and profit.

Dissolutions and Liquidations.—At Grimsby County Court on Friday, Judge Sir G. Sherston Baker, Bart., granted an order for the winding up of Messrs. Sharpe & Co., Ltd., electrical engineers, of Strand Street, Grimsby. It was stated that the trade creditors represented debts amounting to £1,200.

The liquidator of Heaton & Smith, Ltd., of Manchester, has issued a statement. Mr. J. P. Garnett was appointed in May last, and since taking possession he has sold the whole of the machinery, collected the book debts, and realised a large portion of the stock-in-trade. £3,000 has been paid to the debenture holders, leaving about £2,200 still owing in this direction, and there are also

preferential claims for some £210. Until this £2,410 has been wiped out, the ordinary creditors cannot be dealt with. The cash now at bank is £734, and book debts for sales made by the liquidator are £250; he has still to realise the remainder of the stock-in-trade, loose tools, patterns, &c., by auction, and the land, buildings and motive-power plant will be disposed of by private treaty. The unsecured creditors' claims stand at £3,500.

Messrs. R. and F. Wilson and G. Langley (Wilson Bros., electrical engineers and manufacturers, Bedford) have dissolved partnership. Messrs. R. and F. Wilson will attend to debts.

The first meeting and public examination of G. Jackson and D. Smith (Jackson & Smith, electrical engineers, Carlisle) have been arranged for February 22nd at Carlisle.

The St. Ermin's Hotel Telephone Installation.—With reference to our article of last week with regard to the telephone installation fitted by the Private Wire and Telephone Installation Co., Ltd., of Westminster, in the St. Ermin's Hotel, we are desired by the contractors to say that the telephones themselves were manufactured and supplied by the Berliner Telephone Manufacturing Co., Ltd., of 117, Queen Victoria Street, and not by the Western Electric Co., who made the switchboard.

Steam Meter.—We are asked to state that all correspondence relating to the patent steam meter which was described in our last issue, be addressed to Mr. W. J. Bamber, 143, Stamford Street, Brooks Bar, Manchester.

May-Oatway Installations.—The following are the successful tenderers for contracts recently advertised by the May-Oatway Fire Appliances, Ltd.:—The premises of the Govan Ropework Co., Ltd., Govan: Messrs. Carrick & Topping. Those of Messrs. Jas. Templeton & Co.: Messrs. Wylie & Lochhead, Ltd.

The Reavell Patent Air Compressor.—We have received from Messrs. Reavell & Co., Ltd., of Ipswich, copies of their 1904 catalogues dealing with air compressors. The popularity of this firm's make of compressor is well known—not only in connection with mining and kindred operations, but also in the portable form, as a very necessary adjunct to the larger central stations for dust cleaning purposes. The two lists before us deal respectively with single and two-stage compressors; describing and illustrating the construction and operation of both types in conjunction with direct-coupled electric motors and high-speed steam engines. The Reavell compressor, it may be remembered, has four cylinders arranged radially in a circular casing, making an exceedingly compact machine, and reducing the variations of driving power within very small limits. This renders the machine particularly suitable for efficient electrical driving, and as an added advantage, a practically steady delivery of air is obtained without the use of a large reservoir. Automatic control, in the electrically-driven machines, can be effected by two methods; either a variable speed motor, with a suitable resistance controlled from the delivery pipe, or a constant speed motor, automatically stopped and started by means of an air-controlled motor switch, being employed. All the compressors are single acting, all the parts being in constant thrust, also suction valves are dispensed with, and delivery valves of the multiple type, interchangeable for all sizes of compressors, are adopted. We recently had an opportunity of visiting the works of this firm, and were then impressed by the large amount of attention which was being bestowed upon the Reavell air compressor.

For Sale.—Messrs. J. Davey & Co. are on February 24th to sell by auction two 10 nominal H.P. engines, and direct-current dynamos, switchboard, &c., for the Electric Timber Seasoning and Preservation Co. On March 24th, Messrs. Farebrother, Ellis and Co. will offer for sale by auction certain extensive manufacturing premises at Kilburn, having a private siding on the L. & N. W. Railway. Messrs. Wheatley Kirk, Price & Co. are shortly to offer for sale by auction the stock-in-trade, work in progress, &c., at the Salford Switch Works (Heaton & Smith, Ltd., in liquidation). Some particulars respecting the above sales are given in our advertisements to-day.

Re Schüler Lahmeyer Motor.—The Lahmeyer Electrical Co. announce that they have now made complete arrangements for the purchase of the patent Schüler single-phase alternating-current motor, the rights for which were recently held by Messrs. Ferranti, Ltd. The Lahmeyer Co. are now in a position to supply these motors, of which they have already supplied a considerable number on the Continent.

Bankruptcy Proceedings.—The statement of accounts under the failure of Messrs. Gardner Bros. & Co., electrical engineers, of Hornington Street, Burton-on-Trent, shows gross liabilities amounting to £2,860, of which £2,812 is expected to rank against the estate for dividend. There are 49 unsecured creditors. The causes of failure are losses on contracts and lack of capital.

LIGHTING AND POWER NOTES.

Ashford (Kent).—The U.D.C. on February 4th sealed an agreement with the Ashford and District Electric Supply Co., whereby the Council consents to the revocation of its E.L. order, and to the application by the company for another order.

Bangor.—The T.C. has resolved to oppose the Bill promoted by the North Wales Electric Power Co. as far as it affects the area over which the Corporation has statutory powers to supply.

Belfast.—An inquiry was lately held by the L.G.B. into the proposed extension of the electric mains to the residential suburb of Knock. A loan of £4,350 is necessary for the undertaking.

Bridbury and Romiley.—The B. of T. has informed the U.D.C. that unless certain works are carried out, the E.L. order will be revoked. The Council to obviate this, proposes to erect works on a small scale, and the opinion of the residents in the compulsory area is to be ascertained, in order to gauge the possible consumption of energy.

Brierley Hill.—The B. of T. has written to the T.C., stating that it will defer the consideration of the revoking of its E.L. order for one year.

Broxburn and Uphall.—The ratepayers at a recent meeting protested against the decision of the Bathgate District Committee to light the districts by electricity before giving the ratepayers an opportunity of giving an opinion on the matter, and it was unanimously agreed to take a plebiscite of the districts on the question, and forward the same to the County Council.

Brynmawr.—The Breconshire C.C. has resolved not to oppose the U.D.C. Bill for introducing the E.L. into the district.

Canada.—*The British Columbia Review* states that the report under the E.L. Inspection Act, shows that the use of electric light has much increased during the past year. This increase is represented by 236,865 incandescent lights, or their equivalent, or 21 per cent. increase over the year before. Of the provinces, Ontario is by far the largest user, it having 203 out of the 324 electric plants in use in the Dominion. British Columbia shows the largest proportionate increase, it being 82 per cent. The largest plant in the Dominion is that of the Toronto Electric Light Co, 170,000 lamps; that of the Lachine Rapids Hydraulic Co., 158,503 lights next; and the Ottawa Electric Co., with 111,927 lights, third. The work of installing the arc lighting equipment of the Welland Canal is now under way. It is proposed to place an arc lamp of 2,000 C.P., A.C., every 500 ft. along the canal, with six lamps at each lock. It is also proposed to supply energy on the three-phase system to motors, for operating the lock-gates, weirs, bridges, and yard shops. The Lincoln Electric Light and Power Co., St. Catherine's, Ontario, has been given a ten years' contract to furnish the power.

Carnarvon.—It is stated that there are at least three companies anxious to come to an agreement with the T.C., in regard to the electric lighting of its area, viz.:—The National Electric Wiring Co., the North Wales Electric Power Co., and Messrs. A. Salter and A. W. Penrose, London. These latter make four proposals, and state that they contemplate spending about £70,000 to develop the district, the lighting being only a part of a larger scheme; and they intend making Carnarvon the centre of their operations.

The proposals are:—

To take over the provisional order obtained by the Council, with power to the Corporation to purchase; or

To enter into a similar agreement to the one proposed between the National Electric Wiring Co., but with the following additions:—The company to pay the sum of £100 towards the costs of the Wiring Co. in formulating their scheme, and in discharge of any claim they may have against the Corporation; no construction agreement to be required; the rates chargeable to be—For private lighting, 5d. per unit; for public lighting, 3d.; the company undertake to use gas for generating the electrical energy required for this scheme, and to purchase the same from the Council at the rate of 3s. per 1,000 cb. ft.; or

The promoters are prepared to take a lease of the undertaking for 7, 10, or 21 years, and at the conclusion of this period to lend the Corporation the amount required to purchase the works as far as the lighting of Carnarvon is concerned, at 3½ per cent., repayable in 20 or 30 years, according to arrangement with the Council; or

The promoters are prepared to supply the Corporation with electrical energy in bulk at 2½d. per unit.

If the Corporation will let the contract for laying the mains and doing all work in connection therewith—at an agreed price, or to be agreed upon by arbitration—to the promoters, the latter will purchase and use Corporation gas for generating the electrical energy.

If the Council agree with the promoters upon any one of the four proposals, the latter agree at once to apply to the Light Railway Commission for sole power to construct certain electrical railways in the district.

Cheshire Power Scheme.—The promoters of the Cheshire electricity and power gas scheme, for which Parliamentary sanction is being sought this Session, have entered into a provisional agreement with the Power Gas Corporation, Ltd., for an exclusive licence to work the patents of the Corporation in Cheshire, the consideration being the allotment to the Corporation of 25,000 fully-paid £1 shares.

Chippenham.—The Gas Co., the Ratepayers' Association, and several individual ratepayers have decided to oppose the application of the T.C. for a prov. order for E.L.

Clevedon.—The U.D.C. has given its consent to a company securing a prov. order for lighting the town by electricity.

Colchester.—The T.C. has resolved to extend its mains to Nayland village at a cost of £410.

Ealing.—A L.G.B. inquiry was held recently anent the application by the B.C. for power to borrow a sum of £25,000 for electrical purposes. It was stated that in 1902 the revenue had exceeded that of the previous year by £1,721, and that there was an increase in 1903 over 1902 of nearly £3,000. In the past nine months there was an increased revenue over the previous year of £1,873. The expenditure showed an increase every year. Lamp connections had gone up from 36,000 in 1901 to 57,000 in 1903.

Farnworth.—The result of the quarter's working of the U.D.C. electricity undertaking ending December 31st last is as follows:—Number of units generated for all purposes, 209,622; units supplied for lighting and power, 101,521; for traction, 83,831. The total receipts amount to £1,421, and the working expenses, including interest and sinking fund, amount to £1,151, which shows a profit of £270.

Germany.—The plant at the municipal central electric lighting station at Bamberg is about to be extended at an estimated cost of £5,600.

Gorton.—The B. of T. has informed the U.D.C. that it will defer the revoking of the Council's order until the end of June next.

Glastonbury.—The Somerset C.C. will oppose the application of the T.C. for a prov. order for E.L., as the Council, acting under the advice of its Parliamentary agents, could not assent to the insertion of the clauses required by the C.C.

Glasgow.—The T.C. has instructed its clerk to employ agents in London, if found necessary, to appear for it against the applications by the Clyde Valley Electrical Power Co. to the B. of T. for five separate prov. orders to supply electricity in districts adjacent to the city. The report by the deputation of the T.C. Electricity Committee on the question of turbine plant for generating purposes has been issued. The deputation visited Newcastle, Scarborough, Manchester, Rugby, London and Bristol. At Newcastle it inspected the two generating stations belonging to the Newcastle and District Electric Lighting Co., and one belonging to the Newcastle-on-Tyne Electricity Supply Co. At Scarborough were visited the works of the Scarborough Electric Supply Co. Proceeding to Manchester, the party inspected two turbine continuous-current sets of 1,800-KW. capacity at the Dickinson Street works. These sets were reported as giving great satisfaction to the Corporation. The works of the British Westinghouse Manufacturing Co. were next visited; here there were in course of construction a considerable number of turbines, some of which were of 7,000 KW. capacity, intended for the Metropolitan and District Underground Railways, and others of 3,000 KW. capacity for the Clyde Valley Electrical Power Co. At Rugby the deputation inspected the works of Messrs. Willans & Robinson, and those of the B.T.H. Co., and at the latter works inspected one of the Curtis type of turbine engines, built in America, in operation. The deputation next went to London, where the works of Messrs. Yarrow, at Poplar, were visited. The deputation brought their visit to England to a close by inspecting the Bristol Corporation Electricity Works at Temple Back. As a result of these visits the deputation recommended that steam turbines be adopted for the additional plant required for Port Dundas and Pollokshaws Road generating stations, for the reasons that not only was the capital cost, output for output in plant of equal efficiency, very much less than that of ordinary steam engines, but the economy in steam consumption and, consequently, coal consumption, was quite as low as with the best reciprocating engine, at any rate, with plant of the size now required, while the space occupied was very much less. The freedom from vibration was very marked, and the foundations and fixings required were much less in extent, and consequently cheaper in comparison, with what was requisite in the case of the ordinary steam engine. The report was adopted, and acceptance approved of the following offers:—(1) Messrs. Dick, Kerr & Co., Ltd., London, to provide and erect at Port Dundas station two sets of 3,000-KW. steam turbine generators (the turbines to be used, being these made by Messrs. Willans & Robinson, and the generators being those made by themselves), with condensing plant, at a price of £29,145; and Messrs. Willans & Robinson, Ltd., to provide and erect at the Pollokshaws Road station one 1,400-KW. steam turbine with condensing plant and two continuous-current dynamos by Messrs. Siemens Bros., at the price of £8,950.

Kimberley.—According to the *British and South African Export Gazette*, the completion of the De Beers electrical installation, which is to supply the town and outlying districts, will be delayed owing to the non-receipt of material ordered from home firms. Constructive defects in the power station have also been discovered, for which the contractors are to be held responsible.

Kingston-on-Thames.—The T.C. has declined an offer made by Edmundson's Electricity Corporation, Ltd., on behalf of the Twickenham and Teddington Electric Supply Co., to supply energy in bulk to the Corporation's generating station, at a price not exceeding 2½d. per unit.

Knutsford.—The B. of T. has deferred the question of revoking the E.L. Order for six months.

Leigh.—The Electricity and Tramways Committee of the T.C. has resolved that an expert engineer shall be engaged to report on the electricity undertaking and advise as to its more efficient working. The borough electrical engineer has reported that the battery requires overhauling.

Lindsey.—The U.D.C. has decided to oppose the application of the Lincolnshire and Yorkshire Power scheme for powers to erect an electric power station at Market Rasen.

Lincolnshire and Yorkshire Power Scheme.—A meeting of the local authorities affected by the Bill promoted by the L. and Y. Electric Power Co., conferring upon them powers to supply electrical energy over a large area, was held on 3rd inst. at the Guildhall, York. The local authorities of the following towns were represented:—York, Hull, Scarborough, Beverley, Ripon, Harrogate, Bridlington, Filey and Hessle, and it was unanimously decided to oppose the scheme. The Spalding U.D.C. and Lincoln City Council have also resolved to oppose the Bill.

Long Eaton.—The U.D.C. has ordered new plant to the cost of £2,346 for E.L. extensions.

Longton.—The T.C. has reduced the price of energy for power purposes as under:—Up to 500 units per quarter, 2½d.; from 500 to 1,000, 2¼d.; from 1,000 to 1,500, 2d.; from 1,500 and upwards, 1¾d.

A Committee has been appointed to consider the advisability of adopting a free-wiring scheme.

Moffat.—Mr. Forman, C.E., recently sued the T.C. for £75 15s. as fees in connection with a scheme for lighting the burgh by electricity from a "burn." The scheme had not been proceeded with. The Sheriff gave a decree for £37, the Council having already offered that sum, with costs.

Middlesbrough.—The Corporation E.L. Committee has agreed to make application for sanction to borrow £20,000 for extension purposes.

London.—ISLINGTON.—At a recent meeting of the B.C., the Lighting Committee recommended the transfer from the electricity account to the general account of £12,000, to provide for carbons and labour in connection with the street arc lighting. Alderman Mills explained that at present the Municipality was charged 3½d. per unit, and that did not include the cost of carbons and labour, while private individuals and companies were charged from 4d. to 7d. per unit. It was pointed out that the change would mean another ½d. on the rates, and that the recommendation was a scheme to make the electric lighting undertaking appear successful. Islington was now paying excessively for its arc lighting as compared with Hackney, St. Pancras, Hammersmith, and other boroughs which only paid 2d. per unit. It was stated that the undertaking was losing £1,200 by charging too little for the light supplied to the borough. The recommendation was carried. It was pointed out by Alderman Elliott that in 1889 lighting only cost equivalent to a rate of 1⅞d. in the £, whereas now they were paying under this item 4·98d. During the debate it was stated that the whole position of the electric lighting undertaking was being jointly considered by the Finance and Lighting Committees.

HACKNEY.—The B.C. has invited the Stepney Council to approach the L.C.C. to again introduce a Bill, seeking powers to undertake the wiring of premises. It was stated that the opposition of last year would not be repeated, and under these circumstances the Stepney Council are prepared to support the introduction of the measure.

CAMBERWELL.—The B.C. has decided in favour of petitioning against the East London and Lower Thames Electric Power Bill, in order that a clause may be inserted preventing the company from supplying any railway or other company having powers in the borough.

MARYLEBONE.—As a result of the poll of the ratepayers on the question of proceeding with the proposed Bill in Parliament, a majority of 1,176 was declared in its favour. Less than a third of the electors voted.

FULHAM.—The borough electrical engineer has estimated the cost of the various systems of street lighting, as follows:—Gas as at present, total annual cost for 250 lamps, £754 3s. 4d.; incandescent gas, annual cost £862 10s., capital outlay £555; incandescent electric, annual cost £879 3s. 4d., capital outlay £437 10d.; electric Nernst, annual cost £1,004 3s. 4d., capital outlay £687.

WESTMINSTER.—The Works Committee of the City Council reported that it had appointed a sub-committee to arrange with the representatives of the various electric light companies a scheme with respect to the hours during which the companies shall have access to their distributing boxes.

Newbury.—The Urban Electricity Supply Co.'s works, at Greenham, was inaugurated on the 3rd inst.

Newcastle.—The City Council has decided to purchase a new generating set, recently hired in an emergency, at a cost of £4,400.

Newcastle (N.S.W.).—An authority has been received from the Government enabling the Council to borrow £5,000 for the purpose of extending the electric light plant, in addition to the sum of £10,000 already authorised for the purpose of acquiring the plant necessary for the generation and supply of electricity.

Nottingham.—A meeting of the City Council was held recently to consider the raising of additional capital amounting to £100,000 required for completing the equipment of the first section of the electricity station on St. Ann's Well Road, and extending mains, services, &c. The resolution stated that application should be made to the L.G.B. for sanction to borrow that sum. The £100,000 was stated to be required for extensions, and the spending of the money would extend over three years. The principal object in asking for sanction to borrow the whole sum was that one inquiry might suffice. The Electricity Department will require £43,000 or £44,000 during the next few months. The resolution was passed.

Plymouth.—The L.G.B. has forwarded to the T.C. sanction to borrow £36,365 for electricity purposes. The amount applied for was £41,465.

Portsmouth.—A breakdown occurred recently at the electricity works, and is stated to be due to the failure of the turbo-alternators supplied by Messrs. C. A. Parsons & Co. The plant supplied by them consisted of two 500-KW. turbo-alternators, and as the result of an interview with the E.L. Committee, Messrs. Parsons have agreed to alter the present alternators by adding rotating fields of their latest type, and each set so altered is to be capable of a normal working load of 650 KW, the turbines, if necessary, being altered to meet their increased output. The capacity of the plant with these alterations will be 1,300 KW. instead of 1,000 KW. as previous to the breakdown. The cost of carrying out this alteration will be £1,480. The T.C. has adopted the Committee's recommendation that the offer of Messrs. Parsons and Co. be accepted, and that application be made to the L.G.B. for power to borrow £1,500.

Ravensthorpe.—The Yorkshire Electric Power Co. has submitted to the U.D.C. a scale of charges for energy for lighting and power, the figures varying from ½d. to 1½d. per unit. The Council is considering the question of taking energy in bulk.

Rhyl.—The U.D.C. has resolved to join in with the Flintshire C.C. in presenting a petition against the North Wales Electric Power Bill.

St. Annes.—The U.D.C. has decided to arrange terms with Messrs. England, Winstanley & England for preparing plans, &c., in connection with the extension of the electric lighting works.

Southampton.—Owing to the partial change-over from the old works to those now almost completed on the Western Shore, certain alterations to the mains have been agreed upon by the B.C., and it has decided to apply to the L.G.B. for sanction to borrow £1,790 for that purpose.

Southport.—The Chamber of Commerce has appointed a deputation to wait on the Corporation Electricity Committee relative to a reduction in the prices of energy, and to endeavour to induce the Corporation to supply on the flat-rate system.

South Shields.—The E.L. Committee's report states that the works costs, exclusive of public lighting, have been reduced by 14 per cent.; with the public lamps included, the reduction was 12 per cent. The gross profit has increased by 13 per cent., amounting to about £470. For the three quarters of the financial year expired the increase on the total revenue was £1,074. The increase on the total cost to produce that has only been £460.

Sowerby Bridge.—The B. of T. has informed the U.D.C. that it will defer consideration of the question of revoking the lighting order for another 12 months.

Stretford.—The demand for electric light having proved in excess of what was originally estimated, the U.D.C. is considering extensions. The engineer recommends that the electricity works should be enlarged, and additional plant put down, at a cost of £6,750. The Council has instructed him to prepare plans.

Switzerland.—The Communal Council of Lusanna has granted a subsidy of 32,000 lire for electrical power purposes in Ecublens.

Sydney (N.S.W.).—The City Council, it is stated, intended to issue in January a prospectus for a loan of £250,000, to be raised by debentures, for the purposes connected with electric lighting. The works are making rapid progress, and the terms for supply have already been determined by the Council. It is proposed to charge 4½d. per unit for lighting, and 2d. per unit for power, or, at the option of the consumer, 5d. per unit for lighting for the first hour per day, and 2d. per unit for all in excess of this amount on the maximum demand system.

Tavistock.—The U.D.C. has decided to obtain, if possible, terms from a company promoting a Bill for Electric Lighting in the town, for the eventual acquisition of the concern by the Council should it be deemed advisable.

Tay Bridge.—The electric lighting of the Tay Bridge goods station of the N.B.R. was recently inaugurated. The installation comprises about 30 arc lights.

Torquay.—On the 2nd inst. it was recommended that the T.C. should apply to the L.G.B. for sanction to borrow £42,500 for the equipment of an electricity undertaking, made up as follows: Buildings and chimney shaft, £14,500; boilers and machinery, £28,000. It was stated that as the Council has entered into a contract with the Dolter Electric Traction Co. to supply energy for the working of its system, it was necessary to carry out the undertaking as soon as possible.

Walsall.—The electrical undertaking of the Corporation shows a profit during the past year of £314, as compared with a deficit of £244 for the previous year. A sum sufficient to wipe off the deficiency has been appropriated, and the balance of £70 is to be carried to the reserve fund.

The Guardians have decided to adopt electric light for illuminating purposes in the new infirmary buildings.

Walton-le-Dale.—The Lancashire C.C. has decided to oppose the prov. order being sought by the U.D.C. for electric lighting powers in order to obtain protective clauses.

Wednesbury.—The T.C. has accepted a loan of £11,000 for electricity supply purposes, and has decided to re-engage Mr. F. J. Warden-Stevens to supervise the working of its undertaking for 18 months.

West Ham.—At Tuesday's meeting of the Corporation the Finance Committee reported that owing to the magnitude of the work already in hand, it regretted being unable to proceed with the electrification of the lines acquired from the North Metropolitan Tramways Co. in High Street, and the Romford and Leytonstone Roads. The electrical engineer reported that the East London and Lower Thames Electric Power Bill was likely to seriously affect the borough's undertaking, and it was resolved to petition against the Bill.

Weybridge.—The Urban Electric Supply Co. has reduced the price of energy supplied on the maximum demand system from 7d. and 4d. per unit to 7d. and 3d. This is stated to be in consequence of the extension of the mains to Walton.

Whitby.—A report upon the year's working of the electricity undertaking recently submitted to the U.D.C., states that during the year 1,332 lamps had been applied for. The amount of capital expended up to December 31st last, was £26,240, out of £28,000 authorised, and the amount of capital repaid to date was £1,122. It was further stated that the loss on working during 1902 amounted to £433, but a profit of £57 has been obtained during last year's working.

Widnes.—The Electricity Committee of the Corporation has recommended that the offer of the Mersey Electricity Supply Co., Ltd., for the working of its order be accepted. The company undertakes to provide its own capital, to erect the plant in a given time, to accept a low maximum charge for the electricity, and to hand the undertaking over to the Corporation under satisfactory terms if called upon so to do at any future date. The recommendations of the Committee were unanimously adopted.

Willesden.—The General Purposes Committee reports that, having inquired into the charges against Mr. Ruthven Murray, the Council's electrical engineer, it has found them without foundation. It, however, considered, that Mr. Murray should have obtained the Electricity Committee's consent before his interview with the Tottenham U.D.C.'s consulting engineer. A resolution expressing confidence in Mr. Murray was passed, and subsequently a proposal by the North Metropolitan Electric Power Co. that he should continue in charge of the station, on suitable arrangements being made, was agreed to.

The Council decided to instruct its solicitor to communicate with the Metropolitan Electric Supply Co., requesting them to discontinue, on being asked, the supply of energy to consumers in the parish of Willesden.

It was decided to apply to the L.G.B. to sanction a £20,000 loan for mains, meters, motors, &c.

Wimbledon.—The T.C. has received the sanction of the L.G.B. to the loan of £1,300 required for a water-softening plant. The Council has resolved to install 36 additional arc lamps for street lighting, at a cost of £550, and the L.G.B. sanction to borrow that amount is to be obtained.

Winsford.—The B. of T. has informed the U.D.C. that consideration of the revocation of the E.L. order will stand over for six months. The Council is negotiating for the disposal of the order to the promoters of the Cheshire Electricity Bill.

York.—A report of the E.L. Committee presented to the City Council states that during a period of nine months £6,051 had been received, the cost of production being £3,290, a profit of over £2,700 towards sinking fund and interest remained.

TRAMWAY AND RAILWAY NOTES.

Automatic Signals on the District Railway.—The Underground Electric Railways Co. of London, Ltd., have decided to use an American system of signalling on the 15 miles of double track of the Metropolitan District Railway, and have given the contract for this work to the Westinghouse Brake Co. The signals for this installation will be worked automatically on the Westinghouse electro-pneumatic system, and are about 300 in number, the service in the tunnels being arranged for trains running at intervals of about 1¼ minutes. A new form of combined signal motor and arm will be employed. These motors, together with train stops, relays and other special apparatus, are now being manufactured by the Westinghouse Brake Co., Ltd., at their works at King's Cross, N. This system of automatic signalling has already been in service for some months on the Ealing and Harrow branch of the Metropolitan District Railway.

Batley.—Mayor Druitt's report on the accident which occurred on the electric tramways on January 16th was issued on Tuesday. The report states that the car in question

was a four-wheeled double-decked car, fitted for electric traction on the overhead trolley system, provided with the Westinghouse No. 90 controller, and fitted with the usual hand brakes and the Westinghouse electric magnetic slipper brake. The derailment occurred on the car commencing to round the curve between Thorncliffe Road and Track Road. The line is a single one, and the radius of the centre of the track is 78 ft. The super elevation of the outer rail is 1¾ in., which is as much as can be given, and which is ample for the speed sanctioned round the curve, viz., four miles an hour. The gradient of Thorncliffe Road approaching the curve is at first slightly rising, and then a falling one for a distance of 256 yds., starting at 1 in 100 for 35 yds., then 1 in 30 for 184 yds, and finally 1 in 20 for the remaining 87 yds.

Major Druitt says he examined the track in the locality and found it true to gauge, and in good order, and the derailment was due to the excessive speed at which the car was being driven. The car had not been touched when he (Major Druitt) saw it, and the Westinghouse brake was in good order when he tried it. The car had been subjected to a detailed examination, and all the wires traced from the controller to the resistances, and to the motors, and the Westinghouse brake, but not one loose or shaky connection was found. The report proceeds:—

Taking all the evidence available into consideration, I do not consider that there was any failure of the Westinghouse brake, but that the car got out of hand owing to motorman Bower approaching the corner at too high a speed and failing to apply the brakes in sufficient time to check the car. There is an appreciable interval of time between the moment of applying the Westinghouse slipper brake and the braking effect being felt, during which the car, when on a falling gradient, increases speed, and I think it most probable that Bower, feeling no immediate effect on the car, jumped to the conclusion that the brake had failed, and at once took it off, and intended to stop the car by another method, but had no time, and in his hurry performed the wrong motions.

The only lesson to be learned from an accident like this is that, with a brake actuated like the Westinghouse slipper brake, the motorman requires a higher standard of training than if a mechanical brake is employed. Bower had the usual three weeks' training before commencing to drive a car last August, and appears to be an intelligent man; but I think he was not sufficiently careful on this occasion when approaching the corner where the derailment occurred.

Belfast.—At a special meeting of the Corporation on Monday, a resolution was passed approving of the compulsory purchase of the Belfast Street Tramways and other local systems, and the electrification of the system when purchased. The resolution was necessary in connection with the Bill now in the House.

Burnley.—Last week Burnley celebrated the completion of its electric tramway system. The lines were taken over by the Corporation from the Steam Tramway Co., and converted for electric traction. The Corporation has replaced the old single track by a double one from Nelson to Padiham, a distance of 7 miles, and (including £53,000 for the purchase of the old system) the main line has cost about £160,000. This has yielded a profit, and the Corporation has been able to place £3,000 to a reserve fund. In the summer of last year the branch lines in three sections were begun, and these have now been finished, and are open for traffic.

Coatbridge.—Mr. A. P. Trotter made a B. of T. inspection on 4th inst of the new electric tramway line between that burgh and Airdrie. With the exception of a few minor details, the inspector found everything in order. There are 10 cars, seated for 56 passengers each, which allows of a 10-minute service.

Derby.—At the T.C. meeting on 3rd inst. the Tramways Committee reported that Messrs. Thos. Nash & Sons, who had been appointed to test the electric tramway rails, had reported that certain rails submitted to them for testing were not, as regarded certain constituent parts, in strict accordance with the specification. The Committee, being of opinion that the defects were not of a serious nature, had decided to accept 400 tons of rails which had already been rolled, on the distinct understanding that no further rails would be taken by the Committee which, on the worst results obtained independently, were not absolutely within the terms of the specification. In the course of the discussion which ensued, Mr. Clifford Newbold objected to the Council accepting anything that was not in accordance with the specifications, and stated that if their fair contract clause had been worded as he would have had it, they would never have had these Belgian rails foisted upon them at all. As they had decided to have foreign rails, they should, at any rate, see that they were not inferior to the standard required. It was admitted they were defective, and therefore, why have them? Mr. Haslam said they had been advised by Messrs. Nash to accept 250 tons of the rails and get on with the work without further delay. The report containing the recommendation to accept these rails was carried.

Dudley.—Our local correspondent says:—"The police have a record of eight mishaps on the tramways within four days. Insulators have become fused, electrifying the adjacent poles, as happened when three horses were electrocuted on the Castle Hill; guard wires have fallen, causing great consternation in the vicinity, and in another case a trolley wire got loose from one of the insulators, and hung down within a short distance of the heads of the people who were passing to and fro at the time."

Glasgow.—Some of our friends have been making merry at some misspelling of names which occurred in the Glasgow note on p. 177 of our January 29th issue. Our Glasgow correspondent has since sent in his notes typewritten.

A motion by Councillor Bruce Murray, that a portion of the tramway surplus be utilised towards the reduction of rates, has been defeated in the T.C.

A special Committee has been appointed to consider the whole question of the age limit for children travelling on the cars at half fare.

The question of placing a red spot or band on all electric and gas lamps at the tramway stopping places is under consideration by the T.C.

A dispute having arisen between the Tramways Department and Messrs. Duncan Stewart & Co., Ltd., in connection with the contract for auxiliary engines for Pinkston power station, the matter was referred to Prof. Barr, of the Glasgow University. The Professor tested the engines, and has now advised the Department to accept delivery of the engines, and this has been done.

G. N. and City Railway.—Certain further alterations required by Colonel Yorke to perfect the signalling system are being carried out, and are expected to be completed so as to enable the line to be opened in a day or two.

N.E. Railway.—Considerable progress appears to have been made in connection with the proposed service of autocars between Hartlepool and West Hartlepool. The distance between these places is covered in 10 minutes by the tramways, and it is anticipated that the railway motor coaches will do it in 5 minutes. The new car is fitted with an 85 B H.P. Wolseley petrol engine and generator, driving through motors the two four-wheel trucks on which the 53-ft. coach is mounted. Tramway-pattern controllers are fitted at either end for driving. Seating accommodation is provided for 52 passengers, and the vehicle is upholstered on the standard North-Eastern pattern. It was proposed to have a series of trial runs on the Cawood-Selby Light Railway, and when the cars are perfected, and the Hartlepool service has demonstrated their capabilities, the directors may extend the service to all places.

Leigh.—The Tramways Sub-Committee were empowered to meet the directors of the South Lancashire Tramways Co. with a view to ascertaining upon what terms that company would be prepared to take a lease of the tramways when constructed.

Lifts for London Underground Railways.—The Underground Electric Railways Company of London, Ltd., have placed a contract for electric lifts for the whole of the Yerkes system of tube railways with the Otis Elevator Co., Ltd., of London. The works amount in value to about £350,000. The lifts will be electrically operated from the Chelsea generating station, from which electric power will be furnished for the three railways comprising the system—namely, the Baker Street and Waterloo, the Charing Cross, Euston, and Hampstead, and the Great Northern, Piccadilly, and Brompton Railways. The underground stations will be fitted in most cases with four and in some cases with six lifts each. The lift machinery will be of the Otis type, and special safety appliances and non-flammable material are to be employed throughout the mechanism and its accessories. The contract comprises about 170 lifts, each capable of raising a load equivalent to about 65 passengers, at a speed of 200 ft. per minute. The shafts vary from 40 ft. to 180 ft. in depth; the majority of the shafts will be 23 ft. in diameter, but some will be 30 ft. diameter. The small size shafts will each contain two lifts, the larger size three lifts each.

Lincoln.—A member of the Council the other day urged that body to defer its decision *re* the electrical system to be adopted for the tramways which are to be taken over from the company, as he thought they should consider the G.B. surface contact system.

Liverpool—Southport Electric Railway.—The first trip of an electric train on this railway over the entire length took place early on Sunday morning. At 12.30 a.m. the train left Southport in charge of Mr. Winder, of the L. & Y. Railway Co., and Mr. Rutherford, of Messrs. Dick, Kerr & Co. No attempt was made to get up speed, the trial being more in the way of a test. A stop was made at Seaforth, and the train arrived at Liverpool in about three-quarters of an hour. The return journey was made without a hitch.

L.T. & S. Railway and Electric Traction.—Addressing shareholders of this company at the meeting held on 4th inst., Mr. H. Doughty Browne, the chairman, said:—"He hardly dared to lay much stress on the estimates of experts as to the traffic which the company would obtain when a portion of the system was electrified, but if those estimates were realised, they would all be compelled to admit that it was a good thing to have widened the line in the metropolitan district and to have adopted electricity as the motive power for the future."

Manchester v. Glasgow.—In our issue a week ago we gave some figures purporting to be the gross annual receipts of the Manchester tramways in comparison with those of Glasgow, and one or two other cities. A correspondent has called our attention to the inaccuracy of these figures, and we are now enabled to give, through the courtesy of the head of the Manchester Corporation Tramways Department, the official figures for the year ending December 31st, 1903, with figures for the corresponding period (which we believe to be correct) relating to Glasgow. In explanation of the Manchester returns it should be stated that for the first three months of 1903, the tramway system, under the powers then in force, was not complete. On April 1st about 30 miles of new track were opened, including the Palatine Road and Stretford routes, and this had the effect of swelling the gross revenue for the remainder of the year. The receipts were:—

January 1st to March 31st	£106,700
April 1st to December 31st	471,235
Total	£577,935

The receipts for the financial year ending March 31st, 1903, were only £317,960. For the 12 months ending December 31st last, the Glasgow receipts appear to have been £714,477. Glasgow is, therefore, at present, considerably ahead of Manchester in the item of gross receipts, as it is also in mileage.

Metropolitan District Railway Electrification.—It is interesting to note that the tender of the British Thomson-Houston Co., Ltd., of Rugby, for the motors to be used on the trains of the Underground Electric Railways Co., of London (Metropolitan District Railway, &c.), has been accepted. It will be recalled that the Sprague Thomson-Houston system of multiple unit control was recently decided upon for the trains of the above railway, the contracts being awarded to the British Thomson-Houston Co. after extended examination into the merits of the various systems. This follows the example set by the Central London Railway, Great Northern and City Railway, and the North-Eastern Railway, at Newcastle, and even more recently by the Metropolitan Railway, of Paris.

Newcastle-on-Tyne.—The T.C. on 3rd inst. adopted a recommendation to construct further tramways in the city, and in the urban districts of Walker, Benwell and Fenham, and the parish of Longbenton, and to purchase Scotswood Bridge.

Pemberton.—The U.D.C. has received from the L.G.B. sanction to borrow £16,155 for electricity and tramway purposes. Of this £8,200 is for generating plant; £3,355 for overhead equipment and cables (Ormskirk Road tramway); and £4,600 for overhead equipment and cables (Warrington Road tramway).

Perth.—The question of additional borrowing powers in connection with the Electricity Department of the T.C. was discussed by the committee. It was pointed out that the electrical engineer had estimated that to equip the electricity station sufficiently for the tramways would entail an expenditure of £12,000. It was agreed to ask the engineer to give a detailed report on the subject.

Rochdale.—Application is to be made to the B. of T. for the appointment of an arbitrator, or referee, with respect to the purchase of the tramways.

Salford.—At the meeting of the T.C. last week, reference was made to the financial position of the Tramways Department, and the Chairman of the Committee (Mr. Alderman Linsley) was invited to say whether the report was true that the lines had been worked at a loss, during the last six months, and whether the Committee would be unable to contribute the £10,000 or £12,000 promised in relief of rates during the current year. Mr. Linsley said the statement about the system being worked at a loss was quite untrue, and that the Committee intended to redeem their promise to the Finance Committee. He attributed the reduced receipts during the last half of 1903, as compared with the first half, to continuous bad weather. Mr. Linsley further said that the desirability of reducing the cost of energy to the Tramways Department was under consideration. The Mayor (Mr. Alderman Stephens) remarked that he had seen the report referred to. It was so very exact, that he thought the Tramways Committee must have been responsible for its publication.

Stockport.—Things are not proceeding happily here just now. The Mayor (Mr. Alderman Atherton) has resigned his chairmanship of the Corporation Tramways Committee, and refuses to reconsider his decision. Friction seems to have arisen out of the appointment of the Corporation's Committee clerk (Mr. Eardley) as tramway manager, at a salary of £300. The appointment is defended partly on grounds of economy, inasmuch as a manager conversant with all the details of tramway work, would, it is said, have required a salary of £450. The Town Council held a meeting last Wednesday week, at which the Mayor read a sub-committee's report on the state of affairs at the car-sheds. No fewer than 11 out of the 30 cars in use, the report said, required new wheels, and only 15 regular cars were running. A member said he considered such a state of things disgraceful, and that an experienced man should be engaged to bring order out of chaos. An amendment to the committee's minutes disapproving of their action in appointing Mr. Eardley was carried by 19 votes to 17. It was this that led to the Mayor's resignation of the chairmanship. The vice-chairman (Mr. Councillor Ward) and all the other members of the committee who had supported Mr. Eardley's appointment, followed his worship's example.

A special meeting of the Tramways Committee was held on Saturday morning, when the Mayor—contrary to general expectation—presided. The vice-chairman (Mr. W. G. Ward) and Alderman Atherton, however, declined to reconsider their resignations; and a similar course was followed by other members of the Committee. The question of appointing a new manager was discussed, and it was decided to again submit the name of Mr. Eardley to the Council. The Mayor was requested to convene a special meeting of the Council to discuss the position of affairs, and to reconstruct the Tramways Committee.

Tube Railway Precautions.—In the House of Commons on 8th inst., in reply to a question, Mr. Gerald Balfour said that the precautions which are, or might be, taken against the risk of fire were discussed last autumn between the officers of the Board of Trade and those of the several tube railways open for traffic or in course of construction. The Board's chief inspecting officer of railways and their electrical adviser subsequently drew up a list of recommendations on which the observations of the companies were invited. The replies are not yet complete, but although there may be differences of opinion on some matters of detail, Mr. Balfour has every reason to believe that the views of the Department, so far as not already met will, in the main, be given effect to. When finally settled, these recommendations will be imposed as requirements so far as the powers of the Board extend.

Wolverhampton.—The Dudley Road section of the tramways is now nearly completed. A car was run over the finished portion of the line last week. The work of laying the Willenhall Road section has now commenced. The Board of Trade has also sanctioned the borrowing of £16,514 for tramway purposes. The Tramway Committee has renewed the insurance with the Ocean Accident and Guarantee Corporation, Ltd., covering the liability of the Corporation in respect of accidents caused by tramcars to passengers or third parties in the streets, in limits of £500 for any one accident, and a total of £2,000 in the year at the rate of 30 per cent. on the gross annual passenger receipts.

TELEGRAPH AND TELEPHONE NOTES.

Bournemouth Telephones.—It is reported that the Corporation has adopted a recommendation of the Telephones Committee favouring the establishment of a competitive telephone service, not to be financed and worked by the Council, but by the International Electric Co.

Continental Telephones.—Telephonic communication was opened on December 1st last between Roumania and Bulgaria *vid* Giurgui—Ruscino in conformity with a convention signed for this purpose in February, 1900, between the Administrations of Posts and Telegraphs of the two countries.

London Telephone System.—On Monday, in the House of Commons, Sir T. Dewar asked the Postmaster-General if he would state what progress had been made with the London telephone system, and how much of the money provided for the service had been expended.—Lord Stanley, replying to the question, said that nine Post Office telephone exchanges had been opened in the London area, and three others were in course of construction. On the 4th inst., 15,020 telephones were working in connection with these exchanges. The expenditure for the working lines, and for a large amount of general construction available for the further development of the system and the establishment of additional exchanges amounted, on November 30th, to £1,441,775. Parliament, when providing money for telephone capital expenditure, did not allot a defined portion of that money to expenditure in London; but the sums provided for such expenditure in general will be exhausted by the end of the present financial year, and it is proposed at the earliest opportunity to ask leave to introduce a Bill to provide further moneys for the extension of the system.

Portsmouth.—With reference to the recent decision of the L.G.B. to sanction the borrowing of £8,988 in place of £12,000 asked for, it appears that the sum disallowed has already been expended on the outlying system. The Telephone Committee has decided to send a deputation to the L.G.B. and endeavour to persuade the latter to reconsider the matter. The Committee reports a profit of £700 on last year's working.

Swansea.—The Postmaster-General has decided that the number of subscribers to the Corporation telephones being more than one-quarter of the subscribers to the National Telephone Co., the Corporation will be permitted mutual inter-communication in accordance with the Order of September, 1899.

Telegraph Cable Exports.—The value of the telegraph cables and apparatus connected therewith exported from this country during January last amounted to £177,150, as compared with only £91,077 in the corresponding month of last year, and £586,285 in January, 1902.

Telegraph Rates to Egypt.—It is stated in the *Times* that telegraph rates between England and Egypt will be reduced to 1s. 5d., instead of 1s. 10d. and 1s. 7d., a word, on and from July 1st next, at which date the revised rules and regulations adopted at the recent Telegraph Conference will come into force.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Dominica-Martinique	May 5, 1903	
St. Lucia-Martinique	May 7, 1903	
St. Lucia-St. Vincent	Sept. 19, 1903	Feb. 9, 1904
Trinidad-Demerara No. 1	Aug. 27, 1901	
Mole St. Nicolas-Port-au-Prince	Dec. 16, 1903	
Cayenne-Pinheiro	Aug. 18, 1903	
New York-Hayti	April 18, 1903	
Anjer-Kalianda	Aug. 2, 1903	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tourane-Amoy	Nov. 10, 1903	
Tarifa-Tangier	Jan. 18, 1904	
Gibraltar-Tangier	Feb. 5, 1904	Feb. 7, 1904
Oran-Tangier	Feb. 3, 1904	
Landlines.		
Swakopmund-Windhuk	Jan. 20, 1904	Feb. 5, 1904

Telephone Social.—The Bristol staff of the National Telephone Co., Ltd., and some of their friends, held a social evening on Saturday, January 30th, at the Hannah More Hall, Park Street. The company numbered nearly 120.

Underground Telegraphs.—In the House of Commons on Tuesday, in reply to a question, Lord Stanley said:—The line of pipes for the underground telegraphic cable is now laid continuously from London to Carlisle, and a section of 19 miles is being laid over the Beattock summit in Scotland. By the end of the financial year a double line will also be laid from Manchester to Leeds. The permanent cable will be ready for use as far as Warrington, and it may be possible to employ temporary cables between Manchester and Leeds.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aston Manor.—February 23rd. One 750-KW. steam dynamo. See "Official Notices" to-day.

Battersea.—February 15th. 750-KW. steam dynamo, electric pumps and pipework. See "Official Notices" January 29th.

Battersea.—February 22nd. Coal, stores, carbons and meters for the Electricity Department. See "Official Notices" to-day.

Bermondsey.—February 16th. Lamps, carbons, meters, cables, oils, &c., for one year. See "Official Notices" February 5th.

Blackburn.—February 29th. Stores for the Electricity and Tramways Department. See "Official Notices" to-day.

Camberwell.—February 16th. Engine and dynamo for the Baths. See "Official Notices" February 5th.

Canary Islands.—March 23rd. Tenders are being invited by the Spanish Ministry of Public Works, for the concession for the construction and working of an electric tramway between San Cristobal de la Laguna and Tacoronte (Canaries). Particulars may be obtained from, and tenders are to be sent to, El Ministerio de Obras Publicas, Madrid.

Chili.—June 28th. Tenders are being invited for the public electric lighting of the city of Punta Arenas (Straits of Magellan), which will be opened on June 28th next, at 2 p.m., in the offices of the Municipal Commissioners of that city. Full particulars can be obtained on application to the Chilian Legation, 29, Queen's Gate Terrace, S.W.

Cambuslang.—February 29th. Tenders are invited for engines, dynamos, switchboard, and lamps, main and distributing cables, and other works necessary to provide a complete system of electrical supply within the special lighting district. Messrs. Hunter & Jack, electrical engineers, 101, St. Vincent Street, Glasgow. Specifications on payment of £1, returnable. See "Official Notices" to-day.

Ealing.—February 25th. One 750-KW. steam alternator, condenser, &c. See "Official Notices" to-day.

Edinburgh.—February 22nd. Engine and dynamo of large size. See "Official Notices" January 22nd.

Gravesend.—February 25th. Five motors (½ to 12-B.H.P.). See "Official Notices" to-day.

Greenock.—February 25th. One 400-KW. steam-driven traction and lighting generator. See "Official Notices" to-day.

Hammersmith.—February 24th. Meters, service and fuse boxes. See "Official Notices" to-day.

Hanley.—February 22nd. 500-KW. steam or turbo-alternator, condensing plant, superheaters, &c., for the electricity works. See "Official Notices" January 29th.

Hornsey.—February 29th. Stores and cables for the electricity works. See "Official Notices" to-day.

Islington.—February 17th. Free wiring, and motor hiring. See "Official Notices" January 29th.

Islington.—February 24th. Conduits and mains. See "Official Notices" January 22nd.

Islington.—February 25th. Stores for the Electricity Department. See "Official Notices" February 5th.

Kilmarnock. — February 29th. Pipework, lamps, feeders, switch-pillars, meters, &c., See "Official Notices" to-day.

Kirkcaldy.—The Corporation invite tenders for the wiring complete of the Pathhead Halls, including fittings. Forms of tender with specification and general conditions can be obtained on deposit of £1 1s., which will be returned on receipt of a *bona fide* tender. Wm. L. Macindoe, Esq., Town Clerk, Kirkcaldy, by noon, Monday, February 15th.

Manchester.—March 1st. The Manchester Dock and Warehouse Extension Co. wants tenders for 25 electric hoists and 10 electric fixed cranes. See "Official Notices" January 29th.

May-Oatway Installations.—February 17th. Tenders are invited for several installations on the May-Oatway fire alarm system. See "Official Notices" to-day.

Mersey Railway.—The company is inviting tenders for 12 months' stores. See "Official Notices" February 5th.

Preston.—February 15th. Feeder mains. See "Official Notices" February 5th.

Radcliffe.—February 20th. Station lighting and wiring to motor, testing instruments and accessories. See "Official Notices" to-day.

Rathmines.—February 20th. Coal, meters, carbons and stores for the Electricity Department. See "Official Notices" to-day.

Russia.—The Russian Post and Telegraph Authorities in St. Petersburg are about to invite tenders for the construction of a telephone line between Odessa and Kiew, at an estimated cost of 500,000 roubles.

St. Annes-on-the-Sea.—February 27th. Steam dynamo. See "Official Notices" to-day.

Snowdon.—February 29th. 1¾ miles of 36 in. diameter steel piping for the Portmadoc and North Wales Co.'s power station. See "Official Notices" to-day.

South Shields.—March 12th. The Corporation invites offers for the lease of certain tramways. See "Official Notices" January 15th.

Spain.—February 15th. The Public Harbour authorities at Barcelona are inviting tenders until February 15th for the contract for the establishment of the plant and equipment for the electric lighting of the sheds at the Port of Barcelonnette, and for the operation of the cranes, travellers, &c.

Spain.—February 26th. The Municipal Authorities of Cuenca are inviting tenders until the 26th inst. for the concession for the electric lighting of the town during a period of 15 years. Tenders are to be sent to El Secretario del Ayuntamiento de Cuenca, whence particulars may be obtained.

Spain.—March 21st. Tenders are being invited until March 21st by the Spanish Ministry of Public Works in Madrid for the concession for the construction and working of an electric tramway in the town of Seville. Tenders are to be sent to La Direccion General de Obras Publicas, Madrid, whence particulars may be obtained.

Stockton-on-Tees.—February 16th. A year's stores for the electricity department. See "Official Notices" February 5th.

Stourbridge.—February 26th. Engines and dynamos, boiler, booster, crane and battery, for the U.D.C. See "Official Notices" to-day.

Sunderland.—February 26th. Crane and battery. See "Official Notices" January 29th.

Swindon.—February 15th. Electric wiring of a school. See "Official Notices" January 29th.

Ulverstone.—Tenders are invited for additions to the electrical installation at Ulverstone and District Cottage Hospital. J. W. Grundy & Son, architects and surveyors, Central Buildings, Ulverstone.

CLOSED.

Bradford.—The following tenders have been accepted by the Tramways and Electricity Committees:—

James Russell & Sons, Ltd., steel tramway poles, £662.
Bolckow, Vaughan & Co., Ltd., 700 tons of steel girder rails, £5 13s. 11d. per ton, and 35 tons of steel fish-plates, £7 3s. 11d. per ton.
British Westinghouse Co., 1,000-KW. generator for Valley Road generating station, £3,272.
J. Musgrave & Son, Ltd., slow-speed engine to work up to 2,000 H.P., inclusive of overload, £7,870.

Croydon.—The Corporation has accepted the following tenders:—

Messrs. Dorman, Long & Co., £2,905, for extensions to the electricity works.
Alphons Custodis Chimney Construction Co., £3,823 for the erection of chimney shaft.

Glasgow.—Messrs. Dick, Kerr & Co., and Messrs. Willans & Robinson have secured contracts for installing additional generating machinery into the Port Dundas and Pollokshaws station. The latter firm will sub-let part of their order to Messrs. Siemens Bros. & Co. For further particulars see our "Lighting and Power Notes" to-day.

Hammersmith.—The B.C. received the following tenders for six 100-KW. transformers:—British Electric Transformer Manufacturing Co. (*accepted*), £120 each; Westinghouse Co., £120 each.

Leigh (Lancs.).—The T.C. has accepted the tender of the Horsfall Destructor Co, Ltd., for a four-cell refuse destructor, at £2,204; and that of Mr. J. W. Cowburn for the erection of the buildings, at £4,614.

Newcastle-on-Tyne.—We learn that a further repeat order has been placed by the Corporation with the British Westinghouse Co. for magnetic brake equipments. This order covers 30 additional cars, the trucks of which are the Brill 21E type.

(*Continued on page* 269.)

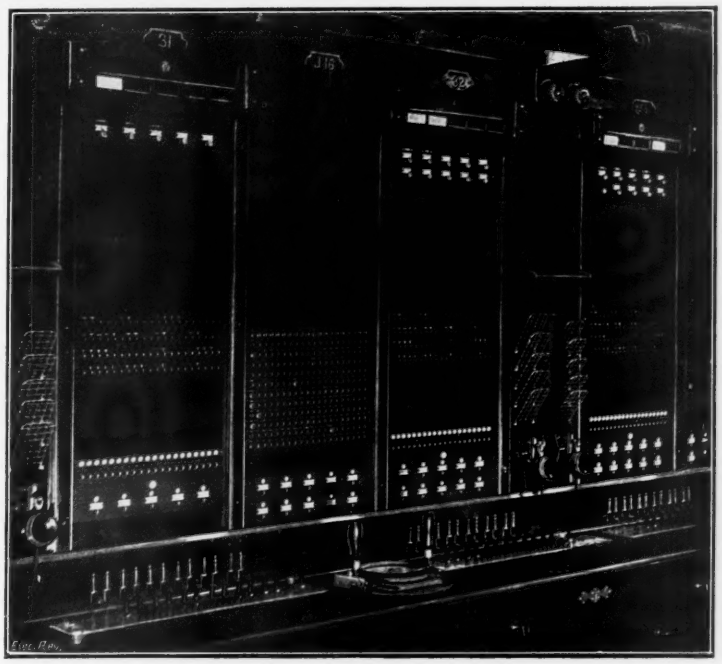
THE NEW TRUNK EXCHANGE OF THE POST OFFICE TELEPHONE SERVICE.

(*Concluded from page* 225.)

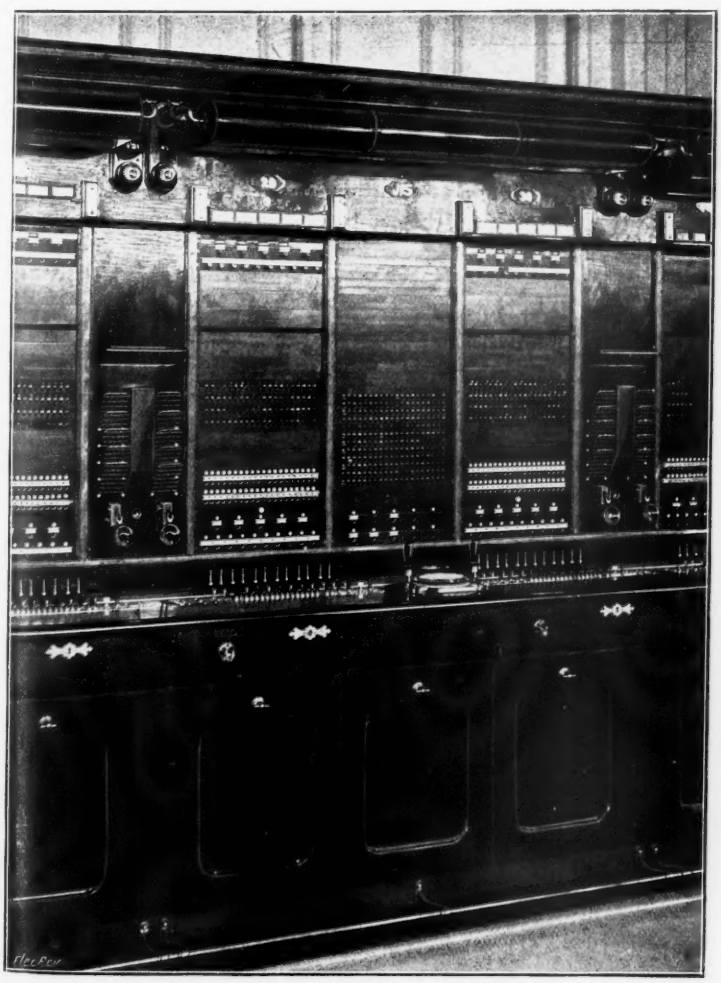
The present equipment of the Exchange comprises 40 operators' positions for provincial trunks, two positions for foreign circuits, one learners' position, two transfer sections, and two reserve positions. The ordinary sections are arranged end to end down two sides of the room, while the remaining sections run round the end of the room. Each switch section is divided into three panels, as shown in the views given herewith. The outer panels each receive the terminals of five trunk circuits, and the multiples of the junction circuits serving the minor local exchanges. The junction circuits of the principal local exchanges are multipled on the middle panel, within easy reach of the operator on either side. These circuits are worked on the call-wire system, and an independent set of call-wire keys connected with the various exchanges concerned is provided at each operator's position. Lamp signals, as already mentioned, are used in all cases for calling, clearing and supervisory signals. The junction circuits terminated on the two outer panels of each section are operated by means of a special "test" arrangement; for this purpose a "test key" is fitted above each of the junction circuit switch-springs in question, and a red signal lamp is fixed in the panel immediately above the group of circuits. If a test key be depressed at any one operator's position while the corresponding circuit is engaged at another position, the red lamp will glow, indicating to the operator making the test that the circuit must not be interfered with. When a trunk operator receives an inward demand for a connection through one of the exchanges terminated in this group, she depresses in succession each test key associated with the junction circuits leading to that exchange, until she finds a circuit disengaged. A red peg (see diagram on p. 266) is then inserted, and this operation causes a calling signal to be automatically given at the local exchange concerned. The red lamp in the trunk operator's cord circuit lights up as soon as the peg is inserted, and continues to glow until the local operator replies.

The number of circuits worked to any one local exchange by this method does not exceed five; when the traffic calls for a greater number of junctions, they are transferred to the middle panel, and worked on the call-wire system.

In all cases the trunk operator directly controls the junction circuit from the time when such circuit is extended to the required subscriber by the operator at the local exchange. A clearing signal is automatically sent over the junction

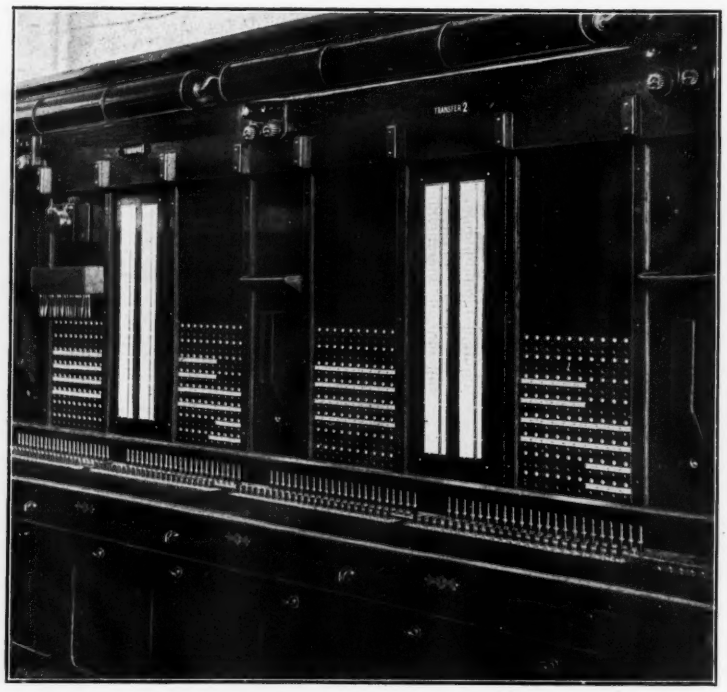


Ordinary Trunk Section.
The insulating plugs are here shown as arranged in the daytime.



"Concentration" Trunk Section.
(Panel 28 is partly shown, with insulating pegs arranged as in the daytime; panels 29 and 30 are shown with the pegs arranged for concentration.)

circuit to the local exchange, when the trunk operator withdraws the connecting peg from the junction switch-spring on the conclusion of a conversation.



Transfer Switchboard, Sections 1 and 2.

The trunk clearing signal is given automatically on the withdrawal of the connecting peg at the distant end of the trunk circuit; the latter are operated on the so-called "permanent current" system, in which opposing batteries of equal E.M.F. are normally connected to the ends of the line when the pegs are withdrawn at both exchanges.

Each pair of connecting pegs and cords (the "cord circuit") is equipped with two signalling lamps—one white and one red. The white lamp glows when a clearing signal is given from the distant end of a trunk circuit, and the red lamp when a clearing signal is sent by a London local subscriber over the junction circuit, or if the connection be accidentally severed at the local exchange.

Each cord circuit is also associated with two keys; one, the ringing and speaking key, is used for ringing on the trunk circuit, and for connecting the operator's speaking apparatus with the corresponding pair of cords; the other, the ringing and disconnecting key, is used for ringing subscribers when required over the junction circuits, and for disconnecting the junction from the trunk circuit, if necessary, to enable the operator to readily ascertain the locality of a fault, or to temporarily cut off a subscriber from the trunk line without removing the peg while particulars of the call are being passed to the distant trunk exchange (see diagram on p. 266).

A special feature of the switchboard, to which we have already referred, is the arrangement provided for concentrating the trunk terminals at certain positions at night and on Sundays. In addition to the five trunk circuits ordinarily connected with each operator's position, provision is made for terminating 10 other trunk circuits on some of the trunk panels during slack periods. For this purpose 10 auxiliary line springs and calling lamps, together with 10 "concentration" signalling springs, are fitted on these panels; during the daytime an insulating plug is inserted in each of the auxiliary springs.

At the ordinary day position, one "concentration" signalling spring is provided, in addition to the line springs, for each of the five trunk circuits terminating at that point; insulating plugs are inserted in the former in the daytime.

When the time arrives for concentration, the operator at the day position withdraws the insulating plugs from the "concentration" signalling switch-springs of those trunk circuits which are disengaged, and inserts them in the line springs. This operation causes her line lamps to glow, as well as the corresponding auxiliary line lamps at the "concentration" panel. The operator at the latter position then withdraws the plugs from the auxiliary line springs, and inserts them in the corresponding signalling springs, when the lamps at both positions will go out, indicating to both operators that the change-over is completed.

In the event of a trunk circuit being engaged when the time arrives for concentration, the operator at the day position delays its transfer to the night position until the conversation is finished, and the operator at the latter point does not interfere with the connections until she receives the recognised signal. This arrangement ensures the concentration of the circuits without confusion or noise, and without the intervention of a test clerk. It also prevents the accidental interruption of any conversations which may be in progress when the authorised time for concentration arrives. The whole operation should be completed within five minutes, instead of one or two hours, as was formerly the case. It is also possible to partially concentrate the circuits as the traffic gradually falls off, one operator attending to 10 circuits at one position in the concentration group, while one operator works 10 circuits spread over two panels at the day position.

Inside of a record section for Local Subscribers. Transfer section passing calls to Stock Exchange and Baltic. Inquiry section, used for answering inquiries of subscribers.

Some of the Record Apparatus on the Centre Tables.

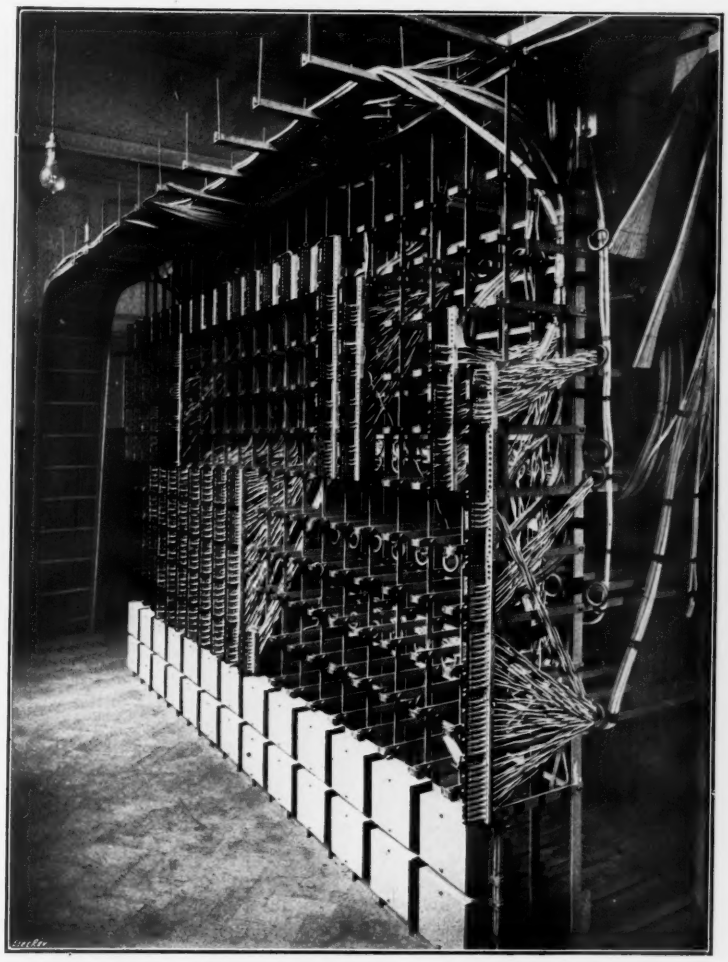
It will be seen that none of the circuits are actually thrown out of use during the slack period; the concentration simply brings a greater number of trunk circuits within the reach of each operator at one part of the switchroom.

In addition to the regular concentration arrangement, provision is also made for changing over certain of the trunk circuits from the panels on which they are normally terminated to other panels for emergency purposes, as when it is desired to carry out repairs or alterations on any particular panel. This proceeding would only take place on exceptional occasions.

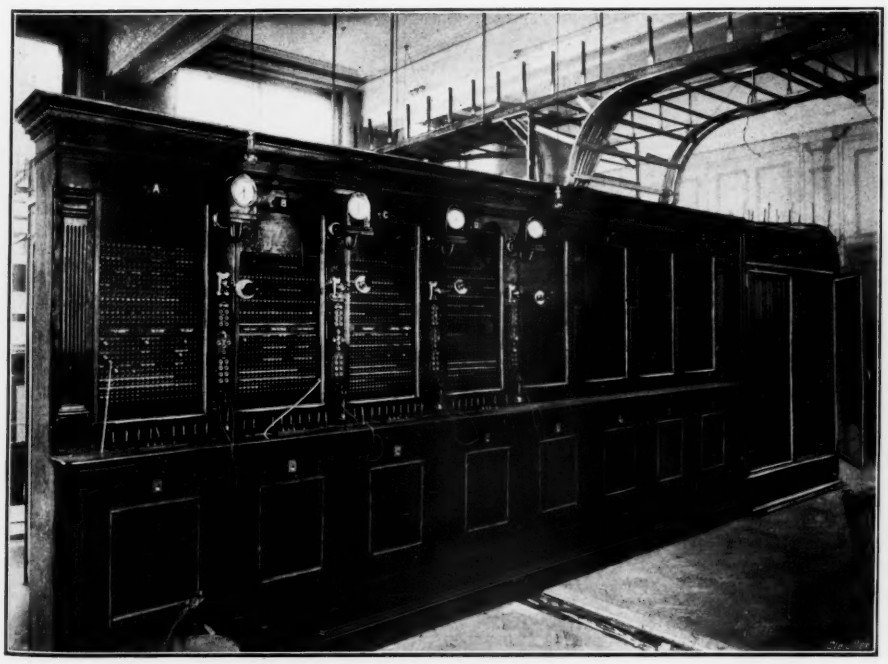
Our view of switch section "J 15" shows two of the "concentration" positions (Nos. 29 and 30) with the insulating plugs arranged as they would be after concentration; the trunk circuits thus concentrated are normally operated on positions at sections "J 16" and "J 17," of which we give a separate view. In the latter case, however, the plugs are shown in the positions corresponding with normal daytime working.

The following is a key to the apparatus at one of the "concentration" sections; the "daytime" sections differ from these only so far as we have already indicated:—Over each trunk panel is a reversible name plate, which in one position shows the destinations of the five trunk circuits dealt with on the corresponding panel in the daytime, and when reversed shows the destinations of the groups forming the 15 trunk circuits dealt with there at night. At the top of the trunk panel is a row of six wire links for disconnecting the corresponding cord circuit relays. Below these are five emergency and 10 ordinary concentration signalling springs. Next is a red lamp for the "test" arrangement, followed by 80 switch-springs and test keys for the minor local exchanges. Below come 40 switch-springs and lamps for transfer circuits; then the pilot lamp; then the five trunk switch-springs and lamps normally allotted to the panel, and the 10 trunk auxiliary switch-springs and lamps for use during concentration.

The middle panel contains 240 switch-springs belonging to the principal local exchanges, five lamps and switch-springs for "A" transfer circuits (three of which are in use).



Intermediate Distributing Frame, Vertical Side; Transformers for Superimposed Circuits at Foot.



Trunk Test Board and Fuse Board.

Between the two operators at each section is a "calculagraph," the clock with time-stamping attachments to which we referred in our last issue. On the front of the switchboard are provided racks for the tickets, and a spare receiver for use when hearing is difficult.

On the keyboard shelf in front of each operator are the pegs and the white and red lamps of six cord circuits, with a green lamp which lights up when ringing a subscriber at a local exchange. In front of these again are the corresponding black and red keys for speaking and ringing, a call-wire ringing key, and a coupling key by means of which the operator's speaking apparatus can be connected with the cords at the next position on the right. Before these keys again is a row of 20 call-wire speaking keys connected

with the different local exchanges. Over each operator's position is a glow lamp mounted on an adjustable reflector, which throws light on the front of the board, but not into the operator's eyes. The lamps are on two separate circuits, and each is controlled by a switch on the board.

for two operators at each section, each having charge of 23 "A" circuits. The arrangements are such as to enable one operator to attend to all or any of the sections during slack periods. The apparatus installed on the transfer boards at each position consists of :—23 single pegs and cords forming

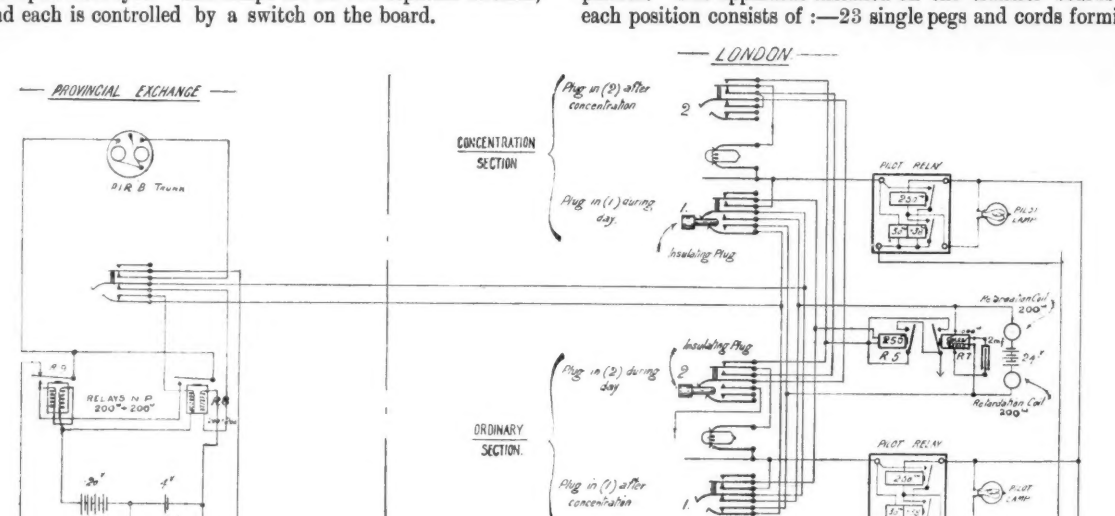


Diagram of Connections of Trunk Circuit. (See explanation on p. 267.)

The switch-springs on the junction panels are divided into groups leading to the respective local exchanges ; the first switch-spring in each group is multipled on the call-wire, and a label plug is inserted into it. In case of failure of the call-wire key, communication with the local exchange can be effected by means of this switch-spring. Certain of the plugs in the switch-springs are distinguished by being encircled with a white ring ; this is to indicate that the exchanges connected therewith are not equipped for automatic signalling on the subscribers' circuits, and therefore the trunk operator must ring the subscriber.

The trunk circuits are used for both outward and inward calls. Where there is only one trunk circuit to a given town, it is generally placed at the disposal of subscribers according to the order in which demands are made at either end for connection. Where two circuits are available, one is sometimes used for inward and the other for outward calls ; where three, the third is used alternately for inward and outward calls, and so on. The method of working is, however, subject to variation to meet the particular requirements of each trunk centre. In some cases "superimposed" circuits are in use; if there are two trunk circuits leading to a certain town, a third can be obtained by using both at once, without interfering with conversations in progress in either circuit—the lead and return wires of one circuit forming jointly the lead of the superimposed circuit, and those of the other ordinary circuit forming the return of the superimposed circuit. Metallic connection between the circuits is prevented by the interposition of transformers.

The "foreign" and "learners'" positions do not call for special description, being generally similar to the ordinary sections. The "transfer" sections are situated at the end of the room, and provide for through connections between trunk circuits. There are 46 "A" transfer circuits terminated at each of the two sections, and provision is made

the ends of "A" circuits from the junction panels ; a lamp and speaking key for each of these—all fixed on the keyboard shelf. On the panel above are about 40 switch-springs forming the ends of "B" circuits to trunk panels, and a number of switch springs communicating with the foreign, reserve, learners' panels, &c.

The transfer circuits are required on account of the necessity of joining trunk circuits through between provincial towns. In order to join any trunk circuit directly with any other, junctions would have to be provided between each section and every other section. This is out of the question in such a large exchange as the one under consideration ; hence, a "transfer" board is used, constituting in effect an exchange within an exchange. Lines are provided from each switch section to the transfer board, which forms the connecting link between the sections. The junction or

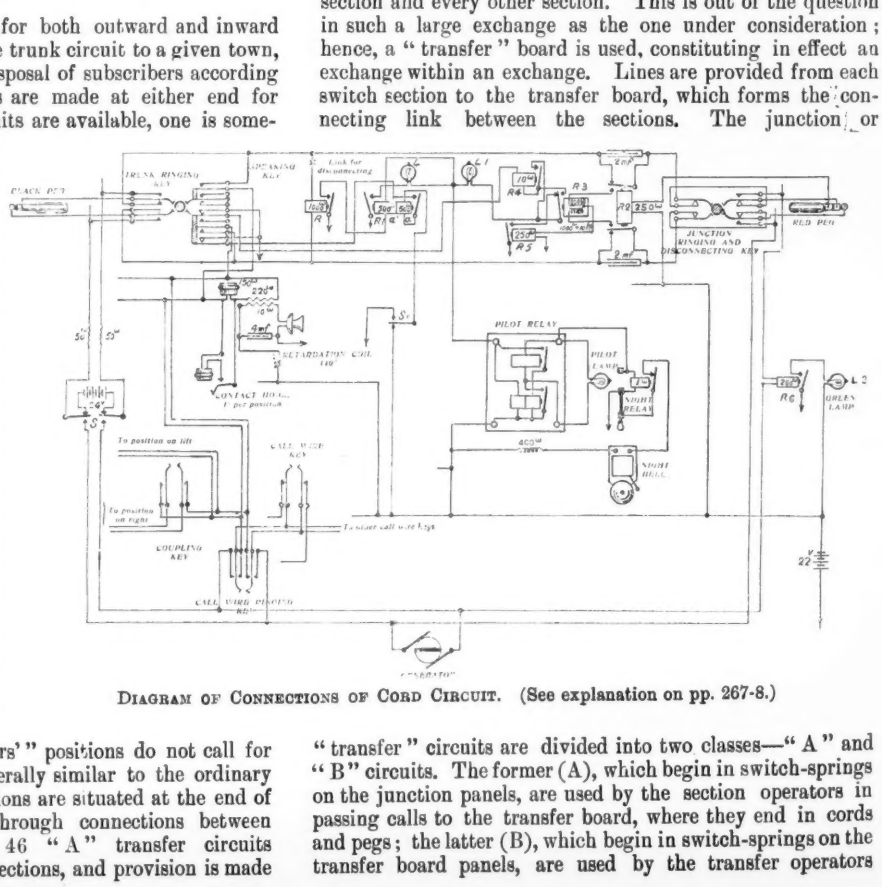


Diagram of Connections of Cord Circuit. (See explanation on pp. 267-8.)

"transfer" circuits are divided into two classes—"A" and "B" circuits. The former (A), which begin in switch-springs on the junction panels, are used by the section operators in passing calls to the transfer board, where they end in cords and pegs ; the latter (B), which begin in switch-springs on the transfer board panels, are used by the transfer operators

in passing calls to the operators at the trunk sections, where they end in switch-springs on the trunk panels. Three "A" transfer circuits are provided from each junction panel to the transfer sections, and two "B" transfer circuits from each transfer section to each trunk panel. In addition to these circuits, there are a number of direct "cross transfer" circuits between certain of the trunk panels (those used for "concentration"), which do not pass through the transfer board. Thus, at slack times the transfer board can be dispensed with entirely.

The insertion of a peg at the trunk section lights a lamp at that point, and another at the transfer board (in the keyboard shelf, in front of a peg). The transfer operator presses a key which puts her speaking apparatus in communication with the "A" transfer circuit thus brought into use; and having learnt the particulars of the call, takes up a peg, which is connected directly with that transfer circuit, and inserts it into the switch-spring of a "B" circuit leading to the proper trunk panel. The act of pressing the speaking key puts out both lamps; and the insertion of the peg lights a lamp on the transfer panel and another on the trunk panel, thus calling the trunk operator. The latter inserts a peg in the corresponding switch-spring, extinguishing both lamps, and putting the cord in communication with the first operator's position through the transfer board; and, after receiving instructions, the third operator inserts the second peg belonging to the cord circuit in use into the desired trunk switch-spring, calls the distant trunk exchange, and the operation is complete.

Provision is made for terminating 15 trunk circuits upon each of the two reserve panels and five on the learners' panel; the transfer of these circuits to the panels in question is effected by means of cross-connection cords on the trunk test board.

The apparatus on the centre tables consists of record sections, receiving calls from local subscribers; a transfer section for passing calls to the Stock Exchange and Baltic cabinets; and an inquiry section used for answering the inquiries of subscribers. As already explained, calls for trunk connections are received on the record sections at the centre tables, where tickets are made out and circulated to the appropriate trunk circuit operators, who, when a trunk circuit is disengaged, call up the provincial exchange and the local subscriber simultaneously. Calls originating from the Stock Exchange (or the Baltic) are similarly received and recorded at the centre tables; the ticket is circulated to the appropriate trunk position, where the operator, when a trunk circuit is free, calls up the Provincial Exchange, and selects a circuit leading to one of the special cabinets provided at the Stock Exchange. Calling up the operator at the latter station on the call-wire, the trunk operator informs the former as to the number of the cabinet with which connection is to be made, and completes the connection with the Provincial Exchange.

Certain subscribers have circuits communicating directly with the Trunk Exchange, where they terminate on two "local sections," which have not been previously referred to. These circuits are used mainly for trunk calls, but may be used also for intercommunication between the local subscribers in question. Transfer circuits are led direct to these local sections from each trunk position. When a local subscriber originates a call, the operator at the local section writes down the particulars on a ticket, which is forwarded to the required trunk position. When the trunk circuit is disengaged, the trunk operator calls the operator at the local position on one of the direct transfer circuits, and gives the number of the local subscriber, who is then called and connected with the trunk circuit.

It will be seen that in almost all cases, a call is received upon one circuit and matures upon a totally different circuit; and when the call matures, the Trunk Exchange operator always calls both parties to a conversation. We may add that if the "wanted" subscriber is at the moment engaged in a local conversation, the trunk call is nevertheless offered to him, and if he refuse to accept it, the originating subscriber has to pay the full charge for the use of the trunk circuit all the same.

The arrangement of the switchboards is generally similar to that of the Central Exchange switchboard, which was fully illustrated in our previous article. An important difference, however, consists in the precautions taken against fire; every effort has been made to diminish the amount of combustible material used in the construction of the board and of the wiring, and practically the whole of the board is lined at the back with "Uralite" with this end in view.

In the adjoining room is the intermediate distributing frame, the vertical side of which is shown in one of our views. This is placed in circuit between the switch sections and the trunk test board, and provides facilities for readily changing the position of any trunk circuit upon the switch sections, with the minimum of inconvenience to traffic.

The trunk test board is also illustrated on p. 265; it is of the switch-spring pattern, which is a convenient form for testing purposes. Two switch springs in series are provided on each trunk, junction, or service circuit, so that crosses can be made with facility. A testing table equipped with the necessary instruments, and the engineer's desk, stand in front of the test board, and the fuseboard, which provides for 900 lines, may be seen at the right hand of the illustration. The following are brief explanations of the diagrams given herewith:—

Connections of Trunk Circuit.

The diagram shows the connections between the trunk section of a provincial exchange and the New Trunk Exchange. The trunk circuits are worked during the day on the equipotential system; at night open circuit working is adopted, with "magneto" calling and clearing.

Normally the "polarised indicator relay" (P.I.R. "B") shows "line free," the pointer being held to the right by a current from the 4-volt battery. When a peg is inserted in the switch-spring, the indicator is cut out of circuit, as well as the battery and the relays R_8 and R_9; the operator at the Provincial Exchange then presses her magneto ringing key, which actuates relay R_7 at the Trunk Exchange, bringing relay R_5 into operation by current derived from the 22-volt battery. R_5 remains closed, and the lamp above the switch-spring lights up. At the same time the pilot relay is actuated, lighting the pilot lamp, which remains lighted so long as any call remains unanswered. At night the switch shown in the right-hand corner is reversed, causing the night relay to act and ring a bell whenever the pilot lamp lights. As shown in the diagram, the insulating plugs at the ordinary and concentration sections determine whether the call shall be received at the former or the latter position, the action being precisely the same in either case. It will be seen also that if either of the insulating plugs be transferred from one switch-spring to another, the lamps at both sections will light up, as explained in describing the "concentration" system.

The operator at the Trunk Exchange answers the call by inserting a peg in the switch-spring, which disconnects the 24-volt battery and the apparatus connected therewith, and at the same time extinguishes the calling lamp and the pilot lamp, unless a call is being made on another trunk circuit ending on the same panel. The trunk operator then receives particulars of the call, and makes the required connection.

The operation of calling a provincial exchange from the Trunk Exchange is as follows:—

The trunk operator inserts a peg in the switch-spring, and presses the battery ringing key in the cord circuit; the relay R_8 at the Provincial Exchange is biassed against the current which flows in the circuit as soon as the peg is inserted, but is actuated by the ringing current, and brings R_9 into action, reversing the indicator needle to the left, where it remains. At the same time the white lamp in the cord circuit of the London operator lights up. When the Provincial Exchange operator answers the call by inserting a peg, the London operator presses the speaking key, to give the particulars of the call; the insertion of a peg at the Provincial Exchange causes the lamp L to be extinguished (see next diagram).

The act of withdrawing the peg at the Provincial Exchange lights up the lamp L just mentioned in the cord circuit at the London Exchange, thus giving the clearing signal. Similarly the withdrawal of the peg at the London Exchange prior to that of the peg at the Provincial Exchange, gives a clearing signal in the cord circuit of the operator at the latter station.

Connections of Operator's Cord Circuit.

The cord ends in a black peg and a red peg, with which are associated white and red lamps on the keyboard, L and L_1, and two keys. When one trunk circuit is connected with another trunk circuit the connections from peg to peg are direct, with only one relay (R) in bridge between the conductors. When the circuit is used for connecting a trunk circuit to a junction, condensers are brought into circuit, and further relays are joined up for subscribers' clearing signals. The black peg is always used for connecting to a trunk circuit; the red peg is used for both trunk and junction circuits.

Relay R is always bridged across the circuit in order to control the clearing signal received from any trunk circuit to which it may be connected. Associated with it are lamp L and relay R_1; the latter simply responds to the movements of relay R, and controls the local circuit of lamp L during the daytime, while the automatic battery signals are in use, but at night when the switch S_1 is reversed, and "open circuit" working is adopted on the trunk lines, it converts transitory ring-off signals into permanent indications.

Relay R_2 is actuated when the red peg is inserted into a junction circuit switch-spring, the sockets of these being earth-connected. Normally, the relay contacts short-circuit the condensers, but when the relay is energised, the short circuits are opened, and relay R_3,

with relay R_5, "in leak," is joined across the cords. R_5 is operated by currents round the loop, or by currents between one line and earth; R_5 therefore responds to magneto clearing signals, while direct currents on the line conductors in parallel have no effect on R_5, but actuate R_5, and so light lamp L_1. The circuit of lamp L_1, which is associated with R_5 and R_6, is so arranged that when R_5 is actuated the circuit is made through the retaining relay, R_4. When R_5 is operated (the armature of R_5 being against the back contact), R_4 is short-circuited. The function of R_5 is to receive the clearing signal from magneto subscribers; R_4 is required to make that signal permanent. R_5 is intended to receive the clearing signal from all subscribers whose circuits are arranged for automatic signalling; a retaining arrangement in connection with R_5 is therefore unnecessary.

The pilot relay is in circuit with the clearing lamps, so that the pilot lamp glows with all clearing signals; at night-time the night relay is switched in also, to give an audible signal on the bell.

Relay R_6 controls the generator green pilot lamp, L_2, which is associated with the junction ringing circuits, and serves also to indicate failure to ring when a fuse has blown, or a line is disconnected.

Switch S_1 is required to join up the retaining coil and relay R_1 to the battery in one position and to short-circuit it in the other, the retaining arrangement being required only when generator clearing is in use on the trunk circuits. The coupling key is used to connect the speaking apparatus with the cords at two or more operators' positions during slack periods.

The trunk ringing and speaking key, in the ringing position, connects up either a 24-volt battery or the generator, according to the position of the switch S, to the black peg; in the speaking position, the key connects the operator's speaking apparatus across the cords, and breaks the retaining circuits of relays R_1 and R_4.

The junction ringing and disconnecting key, in the ringing position, connects the generator with the red peg, and in the other cuts off the junction circuit from the trunk circuit while finding a fault or speaking on the trunk circuit.

The disconnecting link is used for cutting off relay R when testing the cord circuit.

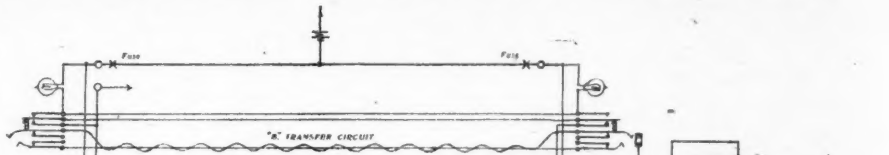
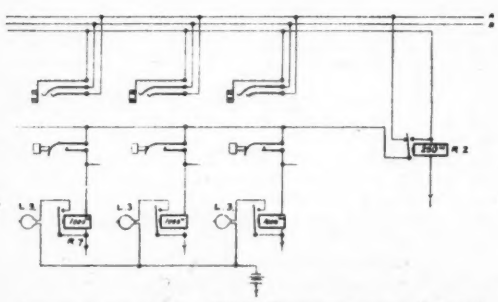


DIAGRAM OF CONNECTIONS OF TRANSFER CIRCUITS.

CONNECTIONS OF TRANSFER CIRCUITS.

A call from trunk section operator is given by inserting peg in switch-spring of "A" circuit in junction panel, lighting lamps at both ends. Transfer operator presses speaking key, putting out both lamps by operation of 1,000 ω relay, and closing primary of speaking apparatus.

The call is passed on to another trunk section by inserting the peg shown, in a "B" switch-spring on transfer panel, lighting lamps at both ends. The earthed socket of the switch-spring keeps the 1,000 ω relay in operation after the transfer operator's speaking key is opened, and prevents the "A" lamps from lighting up. The insertion of the second trunk section operator's peg in "B" switch-spring on the trunk panel puts out both lamps, and after receiving instructions, she pegs into the required trunk switch-spring. In clearing, if any one of the pegs be left in a switch-spring, lamps glow at both ends of the corresponding circuit. The coupling key shown enables one operator to attend to two or more sections during slack periods.



JUNCTION CIRCUIT TO C.B.S. EXCHANGE WITH "TEST" ARRANGEMENT.

"TEST" ARRANGEMENT.

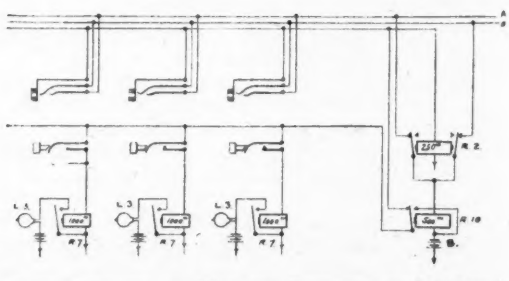
The switch-springs corresponding to junctions to minor "C.B.S." (*i.e.*, "Common Battery Signalling" only—separate batteries used for speaking) local exchanges are multipled, as shown, on the trunk panels. The sockets are earthed through a 250 ω relay R_2. Normally, the "test" keys are connected by the tongue of the relay with the "A" line, which is idle, so that on pressing any one of the keys the lamp does not glow, showing that the junction is disengaged. When the junction is in use, the sockets are raised above earth potential by the collar of the peg, which is connected with a battery, and relay R_2 acts, connecting the "test" keys with the same battery. On pressing one of the keys, therefore, the 1,000 ω relay R_7 is actuated, and the lamp L_3 lights up, showing that the junction is engaged. If after a subscriber has cleared, and the trunk operator has withdrawn the pegs, but before the operator at the local exchange has removed the pegs, a key is pressed, the A line being still connected with the battery at the local exchange actuates relay R_7 and gives the engaged signal.

In the case of the principal local exchanges the "call-wire" is used; in this case the "test" arrangement is omitted, and the bushes of the switch-springs are earthed through a resistance of 250 ω.

The switch-springs connected with junctions to "Magneto" signalling minor exchanges are similarly multipled and provided with the "test" arrangement, as shown. In this case the sockets are earthed through relay R_2, which, however, now has two tongues, normally connecting with both A and B lines. The tongues are joined together, and through a 500 ω relay, R_{10}, with an earthed battery B. As before, when a peg is in any one of the switch-springs, R_2 is actuated, disconnecting both lines from the battery. On pressing the "test" key, the engaged signal is given by the current from the socket of the switch-spring actuating relay R_7. After the trunk operator has cleared, and until the line is cleared at the local exchange, the line is earthed at the latter, so that relay R_{10} acts, and continues the engaged signal by means of battery B.

In the case of "Magneto" exchanges using the call-wire, the "test" arrangement is omitted, and relay R_{10} is replaced by a resistance of 500 ω.

The "test" arrangements in connection with C.B. (Common Battery for all purposes) exchanges are generally similar, but much more simple, the bushes of the switch-springs being connected with the "test" keys, and earthed through a resistance of 250 ω.



JUNCTION CIRCUIT TO MAGNETO EXCHANGE WITH "TEST" ARRANGEMENT.

In concluding this brief account of the new Trunk Exchange, we wish to record our sincere appreciation of the uniform courtesy and ready assistance which we have received from all the engineers of the Department with whom we have come into contact, and to express our thanks to Mr. J. Gavey, C.B., engineer-in-chief, for the facilities afforded us for the preparation of the photographs and description.

The work has been carried out to the Department's specification by the British Insulated and Helsby Cables, Ltd., of Prescot and Helsby. The installation is of the highest class as regards both workmanship and material, and the new apparatus has worked smoothly and well from the start. The change-over will be entirely completed in the course of a

few days, and the old Exchange in St. Martin's-le-Grand will then be closed. That the improved system of operation, and the greater facilities provided, will result in more expeditious and satisfactory working, can hardly be doubted.

CONTRACTS CLOSED.

(*Continued from page* 262.)

Salford.—The Tramways and Electricity Departments have accepted the following tenders:—Messrs. J. Fowler & Co., Ltd., Leeds, panel for switchboard, £60; Smith & Coventry, Salford, large lathe, £294 10s., small ditto, £157 10s., radial drill, £196; Kendall & Gent, Manchester, planing machine, £232; Hulse & Co., Salford, shaping machine, £109, milling machine, £105, screwing machine, £42, punching and shearing machine, £98; Holroyds & Co., Milnrow, light drill, £50; Cunliffe & Croom, Salford, sensitive drill, £18; Miller & Co., Edinburgh, wheel press, £85; Cravens, Ltd., Manchester, wheel borer, £275; B. & S. Massey, Manchester, power hammer, £130; Tattersall & Co., Blackburn, emery grinder, £32; Davidson & Co., Manchester, blowing fan and motor, £51; Reavell and Co., Ipswich, air compressor, £78, air receiver for same, £22; Binns & Co., Halifax, bending rolls, £60; Lumsden & Co., Gateshead, oil groove cutting machine, £44; Herbert & Co., Manchester, hack saw, £23; Carter's, Ltd., Salford, oil pumps, £7, oil cisterns, £21 17s. 6d., grindstone, £12, shafting brackets and bearings, £203 4s. 6d.; Lees & Co., Hollinwood, band saws, £67; glue kettles, £3 5s. 6d.; circular saw, £25 10s.; small saw, £16 10s.; wood planer, £34; panel thicknessing machine, £31 15s.; Robinsons & Co., Rochdale, mortising machines, £77 7s. 6d.; Burton, Griffiths & Co., London, rail saw, £26 15s.; Selig, Sonnenthal & Co., London, portable cranes, £30; British Thomson-Houston Co., Ltd., portable electric drill, £70 10s.; British Westinghouse Co., Ltd., rebabbiting plant, £120; Hadfields, Ltd., Sheffield, and Baker & Co., Rotherham, steel tired wheels, £9 per pair.

Walsall.—The Corporation has accepted the tenders of Messrs. Arundale & Rowbottom for the electric wiring and fitting of the new Town Hall buildings at £974, and of the Walsall Electrical Co., for supplying and fixing telephones, at £292.

Westminster.—The City Council has received the following tenders for extending the electric lighting system at Marshall Street Baths:—Thos. Potter & Sons, South Malton Street (accepted), £178; Branley & Co., £236; Bakewell & Co., £258; Taylor & Co., £263; Jackson Bros., £265; The District Electric Co., £269; Rider & Co., £359; Tamplin & Co., £405.

Wimbledon.—The U.D.C. has accepted the tender of the Paterson Engineering Co., Ltd., for a water softener and filter, softened water storage tank, &c., for the electricity works extensions, at £1,153.

FORTHCOMING EVENTS.

Friday, February 12th.—At 8 p.m. Physical Society. Annual general meeting at the Royal College of Science, S.W. Dr. R. T. Glazebrook, F.R.S., will deliver his presidential address on "The Theories of Microscopic Vision," illustrated by experiments.

At 8 p.m. Institution of Civil Engineers (Students). "The Electricity and Destructor Station at Plumstead," by T. S. Nash.

Society of Motor Manufacturers and Traders. Automobile Show at the Crystal Palace. To be held until the 24th inst.

Saturday, February 13th.—At 6.30 p.m. Junior Institution of Engineers. Dinner at the Hotel Cecil.

At 7.30 p.m. Institution of Electrical Engineers (Glasgow). Meeting at the Heriot Watt College, Edinburgh. Mr. M. Georgi on "New Methods of Electrical Winding Gear for Collieries and Allied Purposes."

Institution of Electrical Engineers (Glasgow). Visit to Messrs. Bruce Peebles & Co.'s works at Edinburgh.

At 7.30 p.m. West Hartlepool Scientific Society. "Balancing of Marine Engines," by Mr. L. V. Robertson.

Monday, February 15th.—Electrical Engineers' Ball at the Hotel Cecil.

Tuesday, February 16th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). "Manchester Tramways Equipment—Line and Rolling Stock," by Mr. J. M. McElroy.

At 8 p.m. Institution of Civil Engineers. "The Forms of Turbines most Suitable for Low Falls," by Mr. A. Steiger.

Wednesday, February 17th.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham). Meeting.

Thursday, February 18th.—At 7.30 p.m. Institution of Electrical Engineers (Leeds). Mr. W. Emmott on "Some Experiments with Large Gas Engines."

Saturday, February 20th.—At 2 p.m. Junior Institution of Engineers. Visit to the Colonial Consignment and Distributing Co.'s Frozen Australasian Meat Stores, Lambeth.

At 3 p.m. Royal Institution. Lord Rayleigh, F.R.S., on "The Life and Work of Stokes." (Lecture I.)

At 7.30 p.m. Glasgow Technical College Scientific Society. "Modern Conceptions of Matter," by Mr. Angus MacLean.

At 7.30 p.m. Institution of Electrical Engineers (Students). "The Testing of Alternating Current Machinery," by Mr. R. J. Kaula.

NOTES.

Bristol Association of Engineers.—The third meeting of the session of this Association was held in the Imperial Hotel, Clifton, on Saturday last, the President, Mr. J. S. Martin, H.M. Inspector of Mines, in the chair, when a paper on "The Development of Electrical Machinery" was read by Prof. Robertson, of the Merchant Venturers' Technical College. Starting with Faraday's discovery, in 1821, of continuous motion produced by an electric current, the author traced out the various stages in the development of electrical machinery up to the present time. He also explained some of the difficulties that are now met with in connection with very low E.M.Fs., very high E.M.Fs, and high-speed machines for turbine driving, and pointed out the chief ways in which they are being overcome. In the discussion which ensued, Mr. Frank Brain gave an account of his experiences of electrical colliery driving. Contributions to the discussion were also given by Mr. Thomas Morgans, Past-President, Principal Wertheimer, and various other gentlemen.

Fatal Accident at Smithfield Electricity Works.—An accident occurred at the works of the Smithfield Markets Electric Supply Co. early on Tuesday morning, and one man who was injured died in Hospital on Wednesday morning. We understand that the circumstances of the accident were these:—A few minutes before 5 o'clock on Tuesday morning, a boiler was opened out to a steam main to which three other boilers were already connected. From some cause, at present unexplained, a fracture occurred in the body of the 5 in. isolating valve in the branch from this boiler (*above* the isolating valve itself) and the four boilers discharged through the gap thus formed. A coal-trimmer, W. Lonergan, was about 15 ft. away from the fractured pipe, and in spite of all efforts, he could not be found for about 15 minutes, when he was conveyed to the Hospital badly scalded. Over an hour elapsed before the stop valves could be approached and the fractured part blanked off. The electricity supply was stopped from 5.6 a.m. until 12.20 noon. Part of the system was, however, restored at 10.45 a.m.

The Royal Society.—The following papers were down for reading at the meeting held yesterday:—"A New Method of Detecting Electrical Oscillations," by Dr. J. A. Ewing, F.R.S. and L. H. Walter; and "On the High-Temperature Standards of the National Physical Laboratory.—An account of a Comparison of Platinum Thermometers and Thermojunctions with the Gas Thermometer," communicated by Dr. R. T. Glazebrook, F.R.S.

I.E.E. (Glasgow).—At a meeting of this section held on February 9th, Mr. Sydney E. Britton read a paper on "Should Electric Supply Undertakings Advance Motors on Hire or Hire Purchase Systems?"

Northampton Institute.—We have received a copy of the *Northampton Institute Club's Gazette*, a chatty eight-page monthly magazine edited by the Librarian of that institute. The sports and recreative sides of the life of the students are well looked after in the session's arrangements, and there is little fear of the students becoming "dull boys" through overwork.

Fatality.—On Monday last, at the electric generating station which is constructing at Chelsea, Ed. Dodd, aged 25, met with his death through falling from a stage where he was superintending the hoisting of some iron work by a hand crane.

Obituary.—The death recently occurred of Mr. Alderman Calvert, the ex-Mayor of Huddersfield, who was chairman of the Electricity Committee.

Personal.—Hull T.C. has increased the salary of Mr. Wm. J. McCombe, tramway manager, from £350 to £400 per annum, rising by annual increments of £25 to £450.

Mr. O. A. Pilcher has resigned the position of borough tramways manager and engineer at Ilkeston.

Appointments Vacant.—Traffic manager for Burton-on-Trent tramways (£175); resident engineer for Holyhead Council's electricity and destructor works; assistant electrical engineer at Bradford, £250; two assistants are wanted for the Stalybridge, Hyde, &c., Electricity Board; assistant clerk for the Woolwich electricity department (£100); mains superintendent for Motherwell (45s.).

Central Station Plant for Sale.—The Launceston (Tas.) Corporation is inviting offers for certain alternating and direct current plant, of which particulars are given in our advertisements to-day.

London County Council.—At the meeting on Tuesday last, approval was given to plans submitted on behalf of the Metropolitan Electric Supply Co., for the construction of a machine and battery room in Fisher Street and Eagle Street, Holborn.

The Highways Committee reported that the experience gained on the New Cross and Greenwich tramways had shown that the number of spare car-ploughs which were purchased was insufficient, and it would be necessary to expend a further sum of £1,500 in connection with the matter. It was decided to authorise the Committee to make arrangements for the supply of the ploughs, and to provide lifeguards for the Streatham cars, at a cost of £360, the guards to be made by the Council's tramway staff. The Committee suggested the purchase of property as a site for a sub-station in Bloomfield Street, E., in connection with the working of the northern tramways.

The offer of the Electrical Power Storage Co. was accepted at £241 5s. for repairing the battery at the Crossness Outfall Works.

Electrical Standardising, Testing and Training Institution.—Prof. C. A. Carus-Wilson will commence a special course of lectures to the senior students upon "Direct Current Motor Construction," on Thursday, February 18th; and Mr. J. B. C. Kershaw will deliver a lecture on "Fuel Economy," on Saturday, February 20th.

South African Notes.—*Middleburg (Transvaal).*—The contract for the lighting of the cantonments of Middleburg has been secured by Messrs. Hubert Davies & Spain, of Johannesburg and Durban, for £14,000, and will be practically a duplicate of the plant supplied by the same firm for the Ladysmith (Natal) lighting, with the exception of the mains being underground instead of overhead.

Transvaal Technical Institute.—It is understood that the scheme of a Transvaal Technical Institute has been finally decided upon. It has been resolved to make arrangements for the conducting of the third and fourth years' courses of the South African School of Mines at Johannesburg, the first and second years' courses being taken, as at present, at Capetown. Premises have been found, and members of the professional staff appointed. Evening classes both at Pretoria and Johannesburg are already arranged. With the establishment of the Johannesburg school, the South African School of Mines at Kimberley will cease to exist. The Council of the Technical Institute have decided upon a staff of four professors. Two gentlemen have been appointed to the mechanical and electrical engineering branches. The senior professor and professor of mechanical and electrical engineering is Mr. H. S. Hele-Shaw, and his assistant is Prof. John Orr, of Kimberley. It is hoped to get the school opened in about six weeks' time, and the fees for the complete year's course are fixed at 30 guineas.

Natal Telegraphs and Telephones.—Considerable developments in telephone and telegraph systems are taking place in Natal. Among these may be noted the following:—New telegraph lines Durban to Howick and Howick to Ladysmith; repoling telegraph line, Melmoth and Ubumbo; new line Vryheid to Paulpietersburg. Transfer of telephone headquarters, Durban. to new premises and introduction of metallic circuits; new line Howick to Shafton and Woodside; Noodsberg Road Station to Noodsberg P.O. and Wartburg; new line Nottingham Road to Loteri; trunk telephone Maritzburg and Durban; new lines from Hlabisa Magistracy to Coalfields, Dundee—Vryheid, Stuartstown to Dreukvlei, and Newcastle to Botha's Pass. Telephone exchanges at Dundee, Newcastle and Ladysmith. The system at Dundee is nearing completion, Newcastle is not started, and Ladysmith was opened last November. The Durban new telephone scheme is well under way, the new Exchange building being about half finished, and it is hoped to have a part of the system at work within 12 months, which is similar to the National Telephone Co.'s system in London. The conduits have been supplied by Messrs. Stanley Bros., Nuneaton, and the laying is about to be commenced by the Corporation. The cables are being supplied by the B. I. and Helsby Cables, Ltd., who have also the contract for the laying of the same; they are of the well-known "air space" class. The capacity of the exchange is 7,500 subscribers.

Tramways and Light Railways Association.—Last Friday a handful of members of this Association met at the Society of Arts and elected six new members of council in place of those retiring under the articles. The new members are:—Messrs. Alfred Baker, C. E. Baker, W. Worby Beaumont, A. N. Connett, J. Devonshire and J. B. Glenn. After the election, Mr. Alfred Baker, manager of the Birmingham Corporation Tramways, the new president, took the chair and delivered a brief address on tramway progress, quoting the recently issued Board of Trade statistics thereanent, and the general advantages of tramways to communities. Some slight alterations in the articles, allowing for longer notice of meetings to be given, were passed, and a vote of thanks to the President closed the meeting.

Fire Test.—A fire test of a novel kind was recently held in the cement works of Messrs. Currie & Co., Ltd., Cathcart Street, Kingston, Glasgow. The test consisted of a platform constructed of timber, part of which was covered with Uralite, the other part being left bare. A timber framed structure was erected, covered with Uralite on both sides. A wooden box covered internally and externally with Uralite was fixed on an iron frame, and placed in the midst of the fire. The fire was lit, and burned for the space of one hour very fiercely, a temperature of 2,000° F. being registered by a pyrometer. The unprotected portion of the platform was destroyed in 14 minutes, but the portion protected by Uralite remained standing, and was able to carry the weight of men standing upon it after the fire was subdued. The wooden framework was opened out after the test in the presence of the spectators, and it was shown that the Uralite had protected the woodwork and entirely prevented the passage of fire. The box was opened, and the contents handed round, absolutely uninjured. The test was witnessed by Government officials, river officials, shipbuilders, fire insurance experts, architects, builders, contractors, brewers and maltsters, and representatives from the various public bodies in the city, the British Uralite Co., Ltd., supplying their speciality for the purpose of the test.

THE CENTRAL STATION ENGINEER.

Dewsbury T.C. has increased the salaries of Messrs. J. H. Thompson and M. Brooksbank, shift engineers at the Electricity Works, from 27s. to 30s. per week.

The Tunbridge Wells T.C. has increased the salary of the assistant electrical engineer (Mr. D. Smith) to £175 per annum.

Mr. T. G. Lumb, A.M.I.C.E., has been appointed engineer to the Blackpool, Lytham and St. Annes Electric Tramway Co.

Bootle T.C. has increased the salary of Mr. J. B. Hudson, deputy electrical engineer, from £130 to £150 a year.

Monmouth T.C. has declined to combine the offices of electrical engineer and surveyor at a salary of £240 a year, but has increased the salary of Mr. Blake, electrical engineer, by £26 per annum.

We understand that Mr. Cramb, who has just been appointed borough electrical engineer at Croydon, is an old student of the Northampton Institute, and he took the Silver Medal and £3 prize two years ago when the Northampton Institute made the record by securing both the Silver and Bronze Medals in the Honours Examination of the City Guilds. Mr. Hamer, another old student in the Electrical Engineering Department, is now chief engineer to the Auckland Harbour Board, New Zealand, and has in hand a large scheme for electric cranes, capstans and other electrical machinery to facilitating loading and unloading steamers at this, the chief port of entry to New Zealand.

At Bradford, on 6th inst., Mr. J. Guildford Halliwell, for 2½ years, motor inspector to the Corporation Electricity Department, who is taking up a similar position at York, was presented with a travelling portmanteau as a token of esteem from the staff.

Mr. W. J. Sowter, borough electrical engineer of Dorchester, is free to accept another appointment, his Corporation having abandoned its scheme.

The Newport (Mon.) Electricity and Tramways Committee has increased the salary of Mr. L. de R. du Verge, the deputy borough electrical engineer and tramways manager from £175 to £200.

CITY NOTES.

Liverpool Overhead Railway Co.

The half-yearly meeting was held on Tuesday at Liverpool, Sir William Forwood presiding.

The Chairman, in moving the adoption of the report (see p. 273), said it might be deemed fairly satisfactory, although not as good as they would like. The number of passengers had gone up from 5,440,000 to 5,896,000, showing an increase of 456,000, or about 8 per cent. The result of this had been an addition to the revenue of £2,951; but he regretted to say that their expenses during the half-year had considerably increased—that they had to spend £2,092 extra to earn that £2,951. A part of this extra expense was for exceptional outlay. They had spent £2,975 in maintenance and renewal of permanent way. The increase in mileage had been 8,000 miles on the railway and 12,500 miles on the tramways. They had put aside, as usual, £2,000 for renewals, and £500 of that sum as a sinking fund for the tramways. Their renewal fund was now £26,559, after deducting £1,000 for the new rails. They had carried £100 to contingent fund, making it £1,150. The receipts per passenger had been 1·93d., a figure which had not varied materially during the past four years. The revenue per train-mile had been 24·47d. The lowest revenue during any half-year was in 1901, when they received 21·60d. The revenue during the past year had been the highest ever reached. The expenditure had been 18·82d. per train-mile, which also marked the highest point reached. In 1900 they spent 15d. per train-mile. The increase was partly due to coal, partly to accelerated service, and partly to increased rates. The result of the half-year's working had been that they had earned revenue amounting to £44,145, while the working expenses were £33,210, leaving a balance of £10,934. They proposed to pay 5 per cent. on the preference shares and 1½ per cent. on the ordinary shares, as against 1¼ per cent. in the preceding half-year. There would be a balance of £4,132 to be carried forward. Alluding to the accelerated service on the railway, he said the increased cost of the generating station with acceleration had been £1,256, of which £817 was spent in coals. They had also an increased cost in their carriage shed of £302—that was to say, with the greater speed at which their trains were running there were more small repairs required in order to keep the system thoroughly efficient. On the other side they had saved in wages of drivers and guards, because they ran fewer trains than under the old system. There was, therefore, a net increase of £916, but there was an increased revenue which they might fairly say was due to

the acceleration, of £6,600 during the past year. Therefore, he thought the directors were abundantly justified in recommending them to expend the £3,000 for the necessary equipment in order to give the accelerated service. They had issued the new preference shares to the extent of £60,000. These were fairly well applied for. This connection with the Lancashire and Yorkshire Railway would be a very valuable one, and would give them a good deal of additional traffic.

Mr. Richard Hobson seconded, and the resolution was carried unanimously.

Several shareholders thought the dividend on the ordinary share very miserable, and suggested the introduction of new blood on the board.

The Chairman said the directors tried to work the company up to a 5 per cent. basis, but they suffered severely by the competition of the Corporation electric cars along the dock system. They were now gradually recovering, and the directors were looking out for new connections.

Somerset and District Electric Power Co.

The first ordinary meeting was held on Wednesday. Mr. P. Napier Miles, who presided, said that that was the first statutory meeting. Considering the great financial and commercial depression that had prevailed throughout the country ever since they were successful in obtaining their Act, the directors had been well advised in hitherto refraining from offering their share capital for public subscription. This did not prevent him saying they had already entered upon negotiations which should shortly enable the company to start upon what they had every reason to believe would be a future of pronounced success. The meeting appointed as directors Messrs. P. N. Miles, Frank Armstrong, E. T. Glyn, and Herbert Conquest.

British Electric Transformer Co.

The report for 1903 shows a net profit of £9,714, after placing £500 to depreciation. £549 is placed to capital suspense, 6 per cent. preference dividend requires £636, 7 per cent. on the ordinary shares absorbs £3,960, £2,000 is place to reserve, £1,000 is written off preliminary expenses, and a balance of £9,715 is carried forward. Works and plant extensions are making great headway. During the year £6,000 was invested, and this is already proving productive in orders.

The meeting is to be held on February 17th at Salisbury House, E.C.

North-Western Electricity and Power Gas Syndicate.

A meeting of this syndicate was held on January 29th at Crewe, Mr. T. W. Twyford presiding.

Mr. W. E. Rowcliffe, solicitor to the company, explained that the meeting was held in order that full information as to the position of the company and the work done should be given to the shareholders, and their opinion taken with regard to the Bill which was being promoted in Parliament, primarily for acquiring further sites for generating stations in the heart of the Potteries. The directors were perfectly satisfied with the company's position, and with the area of supply granted by Parliament, within the limits of which the supply of electricity and Mond gas would be undertaken. Already applications had been received for the supply of power gas, and the North Staffordshire Railway Co. had intimated their intention of using electricity on a larger scale, and would be probable customers of the company. It was intended to erect the first power station at an early date, and plans were already in course of preparation by the engineers.

St. James' and Pall Mall Electric Light Co.

Col. Eustace J. A. Balfour presided at the annual meeting held on Tuesday. In moving the adoption of the report (see Electrical Review, February 5th), he said that for the seventh year they recommended the usual dividend of 14½ per cent. There was nothing to fear from what might at first appear to be a slight setback. They had added 21,873 8-c.p. lamps, making a total of 254,468; the units sold were 7,140,205, or an increase of 255,922; but a small decrease in the price obtained per unit had caused the revenue to remain practically stationary. It must be remembered that they were comparing with a year which was one of exceptional prosperity; it was Coronation year, and had more fogs than 1903. Indeed, in 1902 they made the progress of two years in one. The first six weeks of 1904, he was glad to say, had brought about a most satisfactory increase in sales, and there was every prospect of very largely increased business. The units generated at their own station were 6,662,228, and from the Central Electric Supply Co. they obtained 1,118,082. The cost of the former was normal, but the average cost of electricity sold had been increased by 4d. per unit; this was directly due to the charge of 3d. per unit which had been paid for supply drawn from the Central Supply Co. This rate was fixed to enable the Central Co. to cover the whole of its charges during the past year, which was its first complete year of working. It had either to be done that way, or there would have been a deficit which would have had to be met by the St. James' and Westminster Companies. It was calculated by the joint engineers that the charge for energy to cover expenses this year would hardly exceed 2d. per unit. There was every prospect that, with increased output, the charge would soon be reduced to the cost of production in their own station. The external source of supply had been of the utmost value to them. The apparent set-back in the accounts would be seen to be due to their connection with the Central Co., and it was temporary only, and the association of the two companies had conduced to the advantage of both.

No questions were asked—so unusual as to be almost a disappointment—and the report was adopted, and retiring directors and auditors were re-elected. Thanks to the staff and to the board closed the meeting.

Tyneside Tramways and Tramroads Co.

The report for the half-year ended December 31st, shows that the surplus of receipts over expenses is £1,656, which, together with the balance carried over from last half-year, makes a total of £1,983. Out of this the directors propose a dividend of 2½ per cent. per annum, which will leave £78 to be carried forward, and £400, which is to be carried to a reserve fund for depreciation, &c. The directors call attention to the steady increase of receipts. The report further states that the line along the North Road to Gosforth Park is expected to be finished about Whitsuntide.

Dublin and Lucan Electric Railway Co.

The report for the half-year states that total receipts from all sources show an increase as compared with the corresponding period of 1902, of £212. The total expenditure shows an increase of £113. There has been a reduction in most classes of expenditure, but maintenance and repairs have cost rather more than in the corresponding half-year. £225 included in this half-year's net revenue account is the amount of directors' fees accrued for some time past, which they did not draw, and now relinquish in favour of the company. After providing for debenture interest, there is a balance available of £1,426, out of which it is proposed that a dividend at the rate of 5 per cent. per annum be paid on the preference shares, and that £700 (as compared with £300 in each of the two last half-years) be placed to reserve account for payment on account of electrical equipment, leaving £251 to be carried forward.

British Westinghouse Electric and Manufacturing Co.

Mr. George Westinghouse presided over the meeting held at Hamilton House last Friday, and in moving the adoption of the report, to which reference was made in the Electrical Review for December 25th, 1903, he asked the indulgence of the shareholders for the delay which had arisen in holding the meeting. The directors had delayed it so that he might personally preside, and his movements had been affected by a great increase in the American company's business and the demand which it had made upon him. He then went on to explain why so long a time had been required to get the works into full operation. The most potent factor in delaying the completion of their plant, singular as it might seem, was the phenomenal activity in business which began in America the year the company was registered. This activity absorbed, in a large measure, those most skilled in building and in managing manufacturing plants, and also caused great delay in the delivery of the material and machinery required to complete the plant. Altogether, this unexpected delay, due to a great general prosperity, amounted to fully one year, so that shipments of their own product in moderate amount only began during this present fiscal year, inasmuch as it took a number of months from the time an order was entered and work was begun, before the article could be completed. In this connection, it was not expected that the production of the works would reach a normal condition even this year. The American Westinghouse companies had in consequence of this delay, furnished a large amount of apparatus, and had made a special allowance or deduction of £60,000 as an offset to the manufacturing profit which should have resulted from an earlier completion of the works. This allowance had contributed to the profit required to pay the interim and final dividends on the preference shares for the year ending July 31st, 1903. The dividend for the present year must depend upon the final results as shown by the accountants, and it was not contemplated to pay an interim dividend. The chairman went on to allude to the frequent calls for new capital. The report showed that great efforts had been made to secure new business, and the orders in hand on January 31st, 1904, not executed amounted to £1,608,256. The patterns, new tools and special machinery required in the execution of those orders, and the great amount of labour and material involved before any shipments of complete apparatus could be made, required working capital in proportion. He was satisfied, considering all the circumstances, that the results already achieved had justified the expenses which had been so far incurred. The factory was practically in full working order, the officials and staff had now established extensive trading relations; and he confidently looked forward to results comparable to those obtained by the great companies in America. In regard to the question whether their works had, in view of existing general conditions, been planned upon too large a scale, he unhesitatingly said, "No," and he based this opinion on the development of the electrical business in the United States. Whilst just at this moment the works had a surplus capacity, yet in the near future, in view of the existing developments in this country, there seemed every reason to believe that their present works would not be large enough. The company's trade with the colonies was rapidly increasing. In Australia and New Zealand business generally had greatly improved, and the sales showed a satisfactory increase during the year under review. It had become necessary to establish a separate branch office for Western Australia. In South Africa there had been a marked revival in their business during the

past year, and they had recently arranged for more active representation for extending their connections there, in view of the probable great demand for electrical apparatus for the mines directly the labour difficulty is solved. In India they had made definite arrangements for representation, and had recently secured an order for an extensive power installation, besides a considerable amount of apparatus for the mining district. They believed that there was likely to be an increasingly active demand for electrical apparatus from the British colonies all over the world. It must also be remembered that not only did they manufacture for the home trade and the Colonies, but under the terms of the agreement in relation thereto they had furnished apparatus for several large orders for the execution of contracts in the territory of other Westinghouse companies, notably on the Continent of Europe and in South America, and there were now pending a number of important negotiations. From the beginning it had been apparent to the directors that there should be found a head or chief executive for the company. Men of the required experience and personal characteristics capable of managing a property and business such as theirs were difficult to find. He would have the honour of proposing the election of Mr. William I. Buchanan, who would arrive in London about the 20th of this month, as the deputy-chairman and managing director of the company. Mr. Buchanan, who would, with himself, represent the American company's interests in the British company, had had an exceptional experience in the management of important affairs. The American Westinghouse companies had already shown their confidence in the British company by taking ordinary shares in excess of par value, and he was now authorised by them to take so many of the 100,000 new preference shares at par as might not be taken by the other shareholders. The chairman repeated his remarks made at the last meeting respecting electric railway traction, and added that only one of the lines then referred to—the Mersey—had been put into operation. He also quoted some of the excellent results which had followed the electrification of some American systems, dwelt upon the advantages of the Lamme alternating current motor for railway traction purposes, and made a brief reference to the turbine and large gas engine prospects.

Mr. J. H. Lukach seconded the adoption of the report of the period ending July 31st, 1903.

A Shareholder, whose remarks met with a mixed reception, congratulated the chairman upon the excellent way in which he had utterly ignored the most ugly facts.

Mr. H. W. Birks said that representing a large number of shareholders, he would have liked to have heard a great deal more about the inner life of the company, and something about the business done at Manchester, and the prospects. Why should there be this intolerable delay in issuing the report? They were met with a request for another half a million capital, and with the warning that no interim dividend was to be given. Banks with 300 or 400 branches had already submitted their accounts to the end of December, but six months had elapsed since the Westinghouse accounts were made up. He urged that in future the accounts should be circulated very much more speedily.

Mr. Ferguson asked what proportion of the contracts in 1901, 2, and 3 had been executed up to date; and in regard to the contracts for the past year, what proportion was executed at Trafford Park, and what proportion was supplied from Pittsburg which had allowed the £60,000 discount. The remainder of the £107,609 presumably represented the Trafford Park profit.

Mr. Dingwall pointed out that sundry creditors were over £500,000, whereas sundry debtors were only £219,000, and there was a temporary loan of £141,210, and, further, on the top of these, it was proposed to raise £500,000 new capital. That was surely doubtful policy! The American £60,000 discounts had been given as a favour, and not as a right, and the £47,000 was not sufficient to pay the preference dividend. The proposed new capital would involve a further £30,000 in dividend, but he had heard nothing to justify him in supposing that that could be earned.

Mr. Stevens pointed out that the outlay of £2,000,000 had produced £47,000.

Another Shareholder suggested that the new 100,000 preference shares should rank after the existing 6 per cent. preference shares, for which a 10s. premium was paid last year. This suggestion received support from another speaker, who expressed the disappointment of many shareholders that the dividend had been withheld for three months.

The Chairman, in reply, said that the works were of an unusual character, and the delays in getting things together seemed almost interminable. One of the obligations of the American company was to supply material in the meantime at a low cost—10 per cent. below their ordinary selling price—so long as this company should demand it. They had done this, and in view of the fact that they had a large interest in the matter, they had also made the special allowance of £60,000, which would probably absorb all of their profit on orders that this company sent them. The fact that the earnings were so meagre was not to be surprised at; that they had any available earnings at all under all of the circumstances should be remarkable. Additional capital was required from time to time, and shareholders had had ample notice of it. Concerning the issue of shares at a premium last year, that matter was long under discussion; the shares were then commanding 20 per cent. premium. He offered to take any or all of the issue at £5 10s. To have issued them at less than that price would have been regarded as a hardship upon those who held the shares, or had been purchasing them at a much higher price. The company had the benefit of the premium. The American companies had paid their full amount for the shares they were entitled to take, and were quite satisfied with the investment, and of the present issue they would take at par those not taken up by shareholders. One class of shares was all that the company ought to have. In regard to the amount of contracts the business for the first three months of this year would show a loss, because it was very meagre—they were just getting started. Since then, month by month, the returns had been increasing satisfactorily, and the showing was a good one, considering the circumstances. He looked forward to results commensurate with the business in America. They might have a period of some waiting, but he thought they were progressing in a way which would make the business a sound one in every respect, and make the investment of every shareholder perfectly safe. That was the ultimate object to be obtained. He thought that in future it should be possible to hold the meetings in November at the very latest.

The report was adopted.

A resolution was passed appointing Mr. W. I. Buchanan, deputy chairman, as mentioned in the chairman's speech. Votes of thanks to the executive committee were passed; the auditors were re-elected; and at special meetings which followed, the increase of the capital of the company to £3,000,000 by the issue of £500,000 new shares was approved.

Nernst Electric Light, Ltd.

The manager and secretary has issued a circular to the shareholders respecting a scheme for reduction of capital, for which a resolution was passed at the last meeting, the £100,000 at which the reduced capital would stand being divided up as to £75,000 for the preference shareholders, and £25,000 for ordinary shareholders. The circular, after pointing out the necessity for the reduction, states that the board have taken advice as to the necessary formalities, and they find that having regard to the present distribution of the company's share capital, it is impossible to make an adjustment corresponding precisely with the figures indicated at the general meeting, but if one-half of the preference shares and eight-ninths of the ordinary shares are surrendered, so that the holders of preference shares will remain with one share for every two they hold, and the holders of ordinary shares will remain with one share for every nine they hold (all shares in the future ranking *pari passu*), the capital of the company will be reduced to £90,000, of which the present holders of preference shares will have £70,000 and the present holders of ordinary shares will have £20,000. The scheme of arrangement which has been prepared under the instructions of the board, and of which a print accompanies the circular, is settled on this basis.

The scheme involves two matters; namely, the reduction of the capital, and the adjustment of the rights *inter se* of the holders of preference and ordinary shares. There are technical difficulties in carrying out what is suggested, but the directors hope that this can be done if there is a consensus of opinion on the part of the shareholders in favour of the proposed scheme. If the arrangements now proposed are approved by the body of shareholders generally, it is anticipated that there will be little practical difficulty in obtaining the sanction of the Court. Therefore, before taking the serious step of convening meetings for sanctioning the reduction of capital, and the passing of a special resolution for voluntary liquidation with a view of carrying the scheme through, the directors have submitted the scheme to shareholders to ascertain whether it meets with the approval of not only those who were present at the annual general meeting, but of the body of shareholders at large. Failing receipt from the shareholders of an almost unanimous expression of approval of the proposed scheme, the directors will not take any further action at the moment.

Dublin United Tramways Co.

Mr. Murphy presided at the half-yearly meeting held on 2nd inst. He said that the report was the most satisfactory they had ever been able to present. The receipts increased by £8,346, and the working expenses by only £216. £48,950 was disposable for distribution, and after paying 6 per cent. on the preference, and 6 per cent. on the ordinary shares, placing £4,000 to reserve, £2,000 towards maintenance, and £1,000 to an accident insurance fund, there remained £6,775 to carry forward. £4,000 of the increased receipts was due to the King's visit, and the balance was through normal expansion of traffic which grew notwithstanding bad weather. The receipts from parcels continued to increase, and were £2,873; they constantly received visits from deputations from large English cities, who were anxious to see how their parcels business was organised and conducted. They had made yet another record in cost of producing electrical energy, it being £65 less than in the corresponding half-year, although the number of car-miles run showed a great increase. It cost the company ·438d. for electrical energy to run a car one mile. This they could not hope to beat in future, unless their output which was now 7½ millions of units per annum were largely increased. The report was adopted, after a shareholder had remarked upon the smallness of the reserve (£6,000) considering that the capital account was £1,797,000.

Yorkshire Electric Power Co.

The directors' report to be submitted to the meeting to be held at Leeds, on Tuesday February 23rd, says:—"In the interval that has elapsed since the first ordinary meeting of the company, held in September last, the erection of the station at Thornhill has made progress, the structure of the engine house in particular being pushed forward. A scale of charges for current has been settled, and negotiations with various local authorities, colliery proprietors, and others, for the supply of power, are proceeding.

Lancashire Electric Power Co.

An ordinary meeting of this company was held at Broad Sanctuary Chambers, Westminster, last week.

Mr. F. E. Gripper, who presided, explained the progress of works, and said that the contracts for the machinery were well advanced, that the acquisition of a site of 20 acres situate on the banks of the River Irwell, in Radcliffe, with railway siding accommodation, and adjacent to the Outwood Colliery, had been obtained on a long lease from the Earl of Derby. Tenders for the buildings had been let, and the work of erection had been commenced, and was rapidly progressing. The plant was due for delivery in the autumn, by which time the buildings were to be ready, and the company should be in the position to supply electric power at the beginning of next year. Negotiations were in progress with a number of local authorities who were anxious to have a supply of electricity in bulk.

At the termination of the ordinary meeting, a special statutory meeting was held to sanction an application to Parliament for a new Bill conferring further powers in connection with obtaining sites for generating stations, &c.

Bristol Tramways and Carriage Co.

The directors' report for the year ending December 31st, 1903, shows that the gross receipts for the year amounted to £253,150, and the working and general expenses and renewals are £164,763, leaving a net revenue of £88,387. The following amounts have already been distributed, viz.:—

Interest on 4 per cent. mortgage debenture stock and temporary loans..	£11,301	
Dividend on 4 per cent. preference shares	19,000	
Interim dividend at the rate of 9½ per cent. per annum (subject to income tax), for the half-year ending June 30th	20,099	
		£50,400
And it is proposed to appropriate the balance as follows:—		
Final dividend for half-year at the rate of 9½ per cent. per annum (subject to income tax)	£22,662	
Addition to reserve for contingencies fund	15,325	
		37,987
		£88,387

The interest on investments has also been carried to the credit of the contingencies fund, and the values of the investments having been adjusted to market prices at December 31st, 1903, the reserve funds will now amount to £127,459. The receipts from the tramways department show the substantial increase of £14,771, which is equivalent to about 7½ per cent., although the system of tramways operated compares exactly with the mileage open during the preceding year. The receipts of the carriage department also show an increase of £611. The total number of passengers carried was 44,891,489. A Bill has been deposited by the company in Parliament to authorise extensions of the company's system for about 11 miles on several of the main roads running out of Bristol, which, if authorised, should prove of great public advantage.

Kensington and Knightsbridge Electric Lighting Co.

The directors' report to be presented at the meeting at No. 148, Brompton Road, S.W., on February 18th, reads as follows:—

During the year the number of houses and shops connected with the system has increased from 2,889 on December 31st, 1902, to 3,410 on December 31st, 1903, while the number of lamps calculated on the usual basis of 8 c.p. has increased from 249,870 to 280,133. The renewal account now stands at £50,490, being an increase of £6,285 over the amount of the account at the end of the previous year. After providing for the amount placed to renewal account, writing £3,000 off cost of purchase of Kensington Court Co., Ltd., in the capital account, and after paying the dividends on the 6 per cent. first preference shares to June 30th, 1903, on the 5 per cent. second preference shares to September 30th, 1903, and an interim dividend at the rate of 10 per cent. per annum on the ordinary shares for the first half of the year, the balance standing to the credit of the net revenue account for the year 1903, is £17,773. Of the above sum £1,500 has been appropriated to the payment of the first preference dividend to the end of the year, and £625 has to be set aside to meet the portion of the dividend on the second preference shares accrued to the same date. It is proposed to pay out of the balance of £15,648 5s. 11d. a further dividend on the ordinary shares at the rate of 10 per cent., per annum, for the past half-year, and a bonus of 2 per cent. for the year, making with the interim dividend paid on August 1st, 12 per cent. for the year. This will leave a balance of £8,298 5s. 11d. to be carried forward. It is with the deepest regret the directors have to formally announce the death of Sir Frederick J. Bramwell, Bart., F.R.S., who had been a director since 1889, and chairman of the company from the spring of 1901, and they further have to announce with equal regret the death of Sir Charles Grant, K.C.S.I., who had been associated with the company from its foundation. They have filled the vacancy caused by the death of Sir Frederick Bramwell, by the election of Mr. C. C. Wyllie, jun., and that caused by the death of Sir Charles Grant, by the election of Sir Henry Bliss, K.C.I.E., and they now recommend the confirmation of their choice by their re-election at this meeting. The remaining directors are Lieut.-Col. R. E. Crompton, who on the death of Sir Frederick Bramwell, was appointed by his colleagues, chairman of the company, Mr. G. H. Hopkins, and Mr. R. W. Wallace, K.C.

National Telephone Co.

The directors' report for the half-year ending December 31st reads:—

"The income accrued in respect of the business of the half-year amounts to £941,260, as compared with £868,463 for the corresponding period of 1902, being an increase of £72,797. The working expenses for the half-year amount to £527,284, as compared with £473,268 for the corresponding period of 1902, being an increase of £54,016. The net result for the half-year (after deducting the Post Office royalties, amounting to £86,236) is a profit balance of £327,739, as compared with £316,553 for the corresponding period of 1902, being an increase of £11,186. The rentals carried forward for unexpired terms of running contracts amount to £827,164, as compared with £771,103 at the corresponding period of 1902, being an increase of £56,061. Out of the available balance of £269,422 the board recommend the payment for the half-year of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 5 per cent. per annum on the deferred stock, less income-tax in all cases. The board also propose to transfer £110,000 to the reserve fund, and to carry forward the balance of £10,505. The sum of £413,288 has been expended on capital account during the half-year in the erection of 16,891 additional exchange and private stations and in the construction of underground works."

Anglo-American Telegraph Co.

The directors' report shows that the total receipts from July 1st to December 31st, 1903, including the balance of £1,468 brought forward, amounted to £189,373. The traffic receipts showed a decrease of £13,324, as compared with the half-year ended December 31st, 1902. The expenses, including the repair of cables, &c., amounted to £67,745, being an increase of £3,531.

The sum of £7,193 expended during the half-year on the repair of the 1873 cable has been charged to the renewal fund. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £109,626 11s. 4d. Interim quarterly dividends of 15s. per cent., on the ordinary stock, and £1 10s. per cent. on the preferred stock were paid on November 1st last, absorbing £52,500, leaving a balance of £57,129, out of which the directors recommend the proprietors to declare final dividends of 16s. per cent. on the ordinary stock, £1 10s. per cent. on the preferred, and 2s. per cent. on the deferred stock, amounting together to £56,000, making a total distribution for the year ended December 31st, 1903, of £3 1s. per cent. on the ordinary stock, £6 per cent. on the preferred stock, and 2s. per cent. on the deferred stock. The balance of £1,129 will be carried forward.

Metropolitan District Railway Co.

The directors' report for the last half-year says:—"Electrical traction and equipment is being pushed on with as much rapidity as possible. The power house at Lot's Road, Chelsea, is now being roofed in. The subways from Chelsea to Earl's Court are completed. The sub-stations are well in hand The ducts are completely laid. Contracts for the cables are let. The company's new depôt at Mill Hill Park has been commenced. An arrangement has been made with the Metropolitan Company as to the electrical equipment of the joint City lines, from Mansion House to Aldgate (High Street), and the work is now being rapidly proceeded with."

Newcastle and District Electric Lighting Co.

The report for 1903 states that the installations connected to the company's mains during the year were equal to 15,361 8-c.p. lamps, bringing the total up to about 101,824, and 2,649,841 units of electrical energy have been supplied, as against 2,107,104 units supplied in 1902. During the past year 9,936 yds. of main and branch piping and troughing have been laid, together with 47,780 yds. of main and branch cable. The gross earnings for the year amount to £16,330, and after paying the interim dividend and interest on debentures and loans pertaining to revenue account, the directors recommend the usual dividend of 5 per cent. for the half-year ended December 31st, which, with the interim dividend paid in August last, makes 8½ per cent. for the year, carrying forward £633. Owing to impending extensions, involving certain capital expenditure, and in order to pay off temporary loans, it is proposed to issue 10,000 new shares.

The annual meeting was held at Newcastle on 5th inst., Mr. John D. Milburn, presiding.

The Chairman, in moving the adoption of the report, said they had extensions continually going on, and since the last meeting they had completed arrangements for taking over an order for Newburn and district. They had also practically arranged to supply Newburn. Since the establishment of the company they had paid 96 per cent. upon the capital, dating from 1890.

The Hon. C. A. Parsons seconded, and the report was carried.

An extraordinary meeting was then held, when it was agreed that the capital of the company should be increased by £300,000 by the issue of 10,000 ordinary shares to be sold at a premium of £2 per share.

National Gas Engine Co.

The report for 1903, to be presented at the meeting at Ashton-under-Lyne on the 18th inst., states that the net profit for the year, after deducting ample depreciation on buildings, tools, &c., and allowing for trade expenses and management salaries, is £28,021. The interim dividend at the rate of 5½ per cent. per annum on preference shares and 15 per cent. per annum on ordinary shares, paid on July 31st, 1903, amounted to £9,634, and the sum of £903 has been appropriated to writing down Consols, leaving a balance of £17,423, which, with £8,678 brought forward from last year, leaves a total of £26,102 to be dealt with. The directors propose to pay a final dividend at the rate of 15 per cent. per annum on ordinary shares for the six months ended December 31st, 1903, leaving £16,321, of which it is proposed to place £10,000 to the reserve fund (making it £35,000) and to carry forward £6,321.

The Liverpool Overhead Railway Co.

The directors' report, which was presented at the meeting on Tuesday (see p. 270 of this issue) showed that the gross revenue receipts for the last half-year amounted to £44,145, and the working expenses to £33,210.

The number of passengers carried during the last two years is as follows:—

	Half-year ending June 30th, 1902.	Half-year ending Dec. 31st, 1902.	Half-year ending June 30th, 1903.	Half-year ending Dec. 31st, 1903.
First class	656,756	719,287	759,180	766,160
Second class, including tramways	2,966,690	3,384,621	3,334,793	3,670,404
Workmen (special return tickets)	1,402,976	1,336,396	1,420,116	1,459,939
Total ..	5,026,422	5,440,304	5,514,089	5,896,503

The traffic, both on the railway and tramway, continues to show a satisfactory increase. The working expenses have been considerably augmented by the cost of relaying a portion of the permanent way, a part of which has been charged to revenue, and the balance, £1,000, to renewal fund. The agreement with the Lancashire and Yorkshire Railway is now signed, and it is hoped the work will be completed before the end of the year.

Receipts from passenger traffic amount to £43,277; miscellaneous receipts and interest, £868	£44,145
Less working expenses	33,210
	£10,935
Deduct interest on mortgage debentures	3,800
	£7,135
Add balance brought forward, June 30th, 1903	3,747
Leaving available for dividend	£10,882

The directors recommended the declaration of dividends at the rate of 5 per cent. per annum on preference shares = £3,000, and 1¼ per cent. per annum on ordinary shares = £3,750; leaving £4,132, to be carried forward.

Prospectus.—*Great Northern and City Railway Co.* The company is inviting subscriptions until to-day for an issue of £500,000 5 per cent. deferred ordinary "B" of £10 each, fully paid, at the price of £6 10s. per share. The present issue is offered by and on behalf of the contractors for the line, Messrs. S. Pearson & Son, Ltd. It is estimated that, after discharging debenture interest and the 4 per cent. dividend on the "A" shares, a balance of £28,310 will remain available for the "B" shares, equal to a distribution of over 3½ per cent. on that security, or 5 per cent. on the price at which the shares are now offered. This estimate is based on a traffic of close upon 16 millions per annum.

Portrush and Giant's Causeway Electric Tramway Co.—The annual meeting was held at Portrush last week. Dr. Anthony Traill, who presided, moved the adoption of the report, which showed that the receipts for the year were £3,378, as compared with £3,356 for the previous 12 months. The balance on revenue account, £1,241, had enabled the directors to pay 4 per cent. on the mortgage for £10,000 raised for the purpose of carrying out the Giant's Causeway extension, and £139, interest on temporary loans.

South London Electric Supply Corporation.—The directors recommend a dividend of 3 per cent. on the ordinary shares for the past year.

Telegraph Construction and Maintenance Co.—The directors propose paying a dividend of 10 per cent. (£1 4s. per share), together with a bonus of 5 per cent. (12s. per share), in addition to the 5 per cent. already paid, making 20 per cent. for the year 1903.

Stock Exchange Notices.—The Committee has appointed a special settling day, as under:—Wednesday, February 17th:—Auckland Electric Tramways Co., Ltd.—£200,000 5 per cent. first mortgage debenture stock, and has ordered same to be officially quoted. Application has been made to the Committee to allow the following to be quoted in the Official List:—Perth Electric Tramways, Ltd.—Further issue of £18,287 5 per cent. first mortgage debenture stock.

Morley Electrical Engineering Co.—The annual meeting of shareholders was recently held at Bradford. A 10 per cent. dividend, free of income-tax, was declared.

Northampton Electric Light and Power Co.—After paying dividends on the preference shares, it is proposed to pay 4½ per cent. on the ordinary, and carry forward £209.

STOCKS AND SHARES.

Wednesday Evening.

SOMETHING like a semi-panic seized the Stock Exchange on Tuesday last, and prices were swept downwards beneath the gusts of selling that blew from all sides of the Channel. Paris, Berlin, and New York each contributed its quota to the general realisation, and for a while it became well-nigh impossible to deal in stocks and shares possessing a limited market; not that this remark can be applied in its entirety to the Electricity Supply section, since, although narrow, its specialities were negotiable in most cases without difficulty, although wider prices than usual prevailed for a time. Luckily, the stress of sales did not last very long, and a much healthier tone is now apparent.

On balance, the falls in electricity descriptions are remarkable for their insignificance. Our lists this week certainly show only four rises, but the declines number a mere baker's dozen, and few of them are substantial. The principal movement is a drop of 30s. in Great Northern Telegraph shares, which follows upon a weakening of the market for the past two or three weeks.

Amongst the Supply shares, Charing Cross Ordinary and Preference have both declined ¼ upon consideration of the directors' action in reducing the dividend at last week's meeting. Beyond this, the prices of shares are unaltered, but Chelsea Debenture and Kensington Debenture have risen a point, despite the extreme flatness of purely investment issues elsewhere. Metropolitans at 18½ retain their advance, and satisfaction is felt at the decision of the Marylebone ratepayers to present a Bill to Parliament seeking powers for raising the money necessary to complete the arrangement with the Metropolitan Electric Co. The St. James's and Pall Mall accounts for 1903 are noteworthy for their close approximation to those of 1902. After payment of the same dividend as for 1902, the carry forward is just £48 less than it was a year ago. The prices of the shares now is 15 middle. Electric Lighting and Traction of Australia are 10s. lower at 3½.

In bringing out their prospectus of the Great Northern and City Railway Deferred shares, Messrs. S. Pearson & Son, Ltd, contractors for the line, are boldly facing the difficulties which confront all who appeal to the public for fresh money at the present time. The prospectus has been advertised for several days, so perhaps no extended references to its offer is now necessary. No market is yet established in the shares. The Preferred "A" shares keep at 7½, having been unaffected by the new issue. In fact, all the Tube concerns are marking time, and none of the stocks have changed this week, unless Metropolitans and Districts can be included in this category. The former have lost 2½ points, at 85½, and Districts at 34½ are also duller, in sympathy with the general depression, which is considered sufficiently good reason to mark down any stocks, of which there might possibly be sellers. Two of the City and South London Preferences shed a point apiece.

Of the traction shares, British Electric Ordinary and Preference are ¼ and ½ down to 11 in each case, nor is the market a particularly good one, even at those figures. London United Preference are 11½, and the Debenture stock 104. British Columbia Electric Preferred marks 92⅝ this week. Westinghouse Preference have slumped to 3¾, notwithstanding the optimistic speech made by Mr. George Westinghouse at the meeting. The market dislikes the idea of the interim dividend being postponed, and the speech is criticised as dealing too much with the American company, whereas the shareholders really wanted fuller information in regard to their own property on this side. The new Preference shares stand at 3½, and the Debenture stock is nominally 93 to 96. British Thomson-Houston shares, it may be observed, are practically non-negotiable in the Stock Exchange. There is no quoted price for them, but the 4½ per cent. Debenture stock is 104, which includes the half-yearly interest due in a fortnight's time.

Telegraph descriptions continue their attitude of apparent indifference to the alarums in the Far and Near East. The Eastern group is unchanged, except for a point fall in Eastern and South African 4 per cent. Debentures. Present proprietors of stock are not selling to any extent. On the other hand, the prospect of investors being attracted to Eastern issues upon probable advantages attaching to the companies by reason of the war is not sufficiently certain to justify a marking-up of prices. In the American division, Anglo "A" has slipped back to 7⅝ and the "B" to 95. Great Northerns at 22½ are peculiarly flat, much of the selling having proceeded from the Continent, which sold heavily all round the markets upon the disappointment of its hopes in regard to peace. Last year the lowest price reached by Great Northern shares was $22\frac{5}{16}$, and 25½ marked the minimum in 1902. Globe Telegraph Preference have lost ¼ at 12½, and Submarine Cables are 1 down.

None of the National Telephone issues were affected by the dividend announcements, and the increased dividend of 5 per cent. upon the Deferred has left the price at 80. This, of course, was the rate estimated by the market. Continued prosperity is evidenced by the report, and the company appears to have been benefited by the competition of the Post Office rather than injured. A few manufacturing shares show small fluctuations. Electric Constructions at 1⅛ are half-a-crown easier, and General Electric Preference have dropped ¼ to 9½. Telegraph Constructions are a point higher. Writing about Henley's last week, it was observed that since the day of applying for the new shares "has passed there should be a recovery." At 12½, the present price, Henley's display a rise of 25s. on the week. The new shares have recovered to 1¼ premium.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Feb. 3rd.	Closing Quotations Feb. 10th.	Business done week ended Feb. 10th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼ — 3⅛	2¼ — 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	6½s.	6d/6	6½s.	50 — 53	50 — 53	51	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	95 — 97	94 — 96	95⅞	95
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	7⅜ — 8⅛	7½ — 8	7⅞	7⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	..	4½ — 5¼ xd	4½ — 5¼	..	..
13,383,300$	Commercial Cable	$100	8 %	8 %	..	180 —190	180 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	89 — 91	89 — 91	90½	..
16,000	Cuba Telegraph	10	4 %	6½%	..	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	16 — 17	16 — 17	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	..	2⅜ — 3⅛	2⅜ — 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7⅜ — 8¼	7⅜ — 8¼	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101⅝	98 —101⅝	..	..
60,710£	Direct United States Cable	20	3¼%	3½%	..	10 — 10⅛ xd	10 — 10⅛	10⅛	10⅛
85,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	119 —124	119 —124	122	120½
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	88 — 91	88 — 91	88½	..
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	106	105½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	10¾— 11¼	10¾— 11¼	11	..
820,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107 xd	104 —107	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	98 —101	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	..	..	8½— 8¾	8½— 8¾	8½	8½
180,042	Do. do. 6 % Pref.	10	..	..	..	12¾— 13	12¾— 12¾	12⅞	12⅞
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	..	23½— 24½	22 — 23	..	..
58,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	..	38 — 41	38 — 41	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —103	100 —103	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	102 —104	102 —104	103¾	102
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	78 — 81	78 — 81	79	78
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13½— 14½	13½— 14½	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14⅝	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5⅝	5½— 5⅝	5⅝	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 97	95 — 97	95¾	95¼
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	..	⅞— 1	⅞— 1	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	..	..	6½— 7½	6½— 7½	6¾	..
3,808	Submarine Cables Trust	Cert.	..	..	..	118 —123	117 —122	118	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5½— 6	5½— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4¾— 5¼	4¾— 5¼	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	102 —105	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	2 %	..	5 — 6 xd	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	11⅜— 12¼	11⅜— 12¼	12⅛	11⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	99 —102	99 —102	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	..	..
88,821	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6¼	6 — 6¼	6¼	6⅛
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4½— 5½	4½— 5½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4½— 5⅛	4 — 5	4⅜	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	87 — 91	87 — 91	87½	..
100,000	British Electric Traction	10	9 %	8 %	..	11 — 11⅛	10⅜— 11⅛	11⅜	10⅜
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11¼— 11⅜	10¼— 11⅛	11⅜	11⅛
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —123	120 —123	120⅛	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	..	6 — 6⅛	6 — 6⅛	6⅜	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —107	102 —107	105½	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅜— ⅞	⅜— ⅞	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	..	¾— 1⅛	¾— 1⅛	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	..	1¼— 1⅜	1 — 1⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	97 —100	98 —101	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	75 — 80	75 — 80	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	..	10½— 11½	10¼— 11⅛	10½	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5½— 5¾	5½— 5⅝	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —108	104 —108	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	94 — 97	94 — 97	96½	94½
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	98 —101	98 —101	101½	101
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	91 — 94	91 — 94	..	..
1,330,000	City and South London Railway	Stock	2 %	3⅛%	2⅜%	50 — 53	50 — 53	52	50½
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1⅝— 2	1⅝— 2	1⅝	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	97 —100	97 —100	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	Nil	..	0 — ¼	0 — ¼	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	⅜— 1⅜	⅜— 1⅜	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	..	..
100,000£	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81	76 — 81	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1⅝— 1⅞ xd	1½— 1⅝	..	..
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	2	..	..	..	2½— 3	2½— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100 xd	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9½— 10	9½— 9⅝	9½	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	95 — 98	95 — 98	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	..	11 — 11½	12 — 13	12¾	11½
35,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18 — 19	18 — 19	18⅜	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —108	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	4⅞— 5	4⅞— 5	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
37,350	Telegraph Construction and Maintenance.	12	20 %	20 %	20 %	33 — 36	33 — 36	35	33½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3⅛%	3⅛%	91 — 94	91 — 94	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years			Closing Quotations Feb. 3rd.	Closing Quotations Feb. 10th.	Business done week ended Feb. 10, 1904.	
		‡	1901.	1902.	1903.			Highest.	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	1	..	..	..	¾— 1	¾— 1	..	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅛— 1⅜	1⅛— 1⅜	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	114 —117	114 —117	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	8 %	8 %	10 %	10¼— 10⅜	10¼— 10⅜	10⅜	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	9⅜— 10⅛	9⅜— 10⅛	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	106 —109	106 —109	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	8½— 9	8⅜— 9⅛	8½	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅜— 6	5⅜— 5⅝	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4½— 5	4½— 5	4⅞	..
40,000	Do. do. 1903	5	..	..	..	4½— 5	4½— 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	103 —105	103 —105	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	4 %	4⅓%	5⅓%	5⅜— 6⅛	5⅜— 6	6	5⅛
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	105 —108	106 —109	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	5 %	5 %	..	10¼— 10⅜	10¼— 10⅜	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	121 —126	121 —126	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	101 —104	101 —104	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	..	8 — 9	8 — 9	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11½— 12⅝	11½— 12⅝	11½	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	107 —110	107 —110	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	99 —102	99 —102	100	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	5⅜— 6⅛	5⅜— 6⅛	6⅛	6
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	5⅞— 6¼	5⅞— 6¼	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	103 —106 xd	103 —103	101½	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	10 %	10 %	12%	11 — 12	11 — 12	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞— 2⅛	1⅞— 2⅛	2⅛	1⅞
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅝— 6	5⅝— 6	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	95 — 98	95 — 98	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6½%	7½%	..	18 — 19	18 — 19	18⅝	18⅛
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅛	5⅛
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	109 —113	109 —113	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	95 — 98	95 — 98	96½	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	..	13 — 14	13 — 14	..	..
50 000	Do. do. 4 % First Mort. Debs.	100	..	..	..	99 —102	99 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	8⅝	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	3½— 3⅝	3½— 3⅝	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	85 — 90 xd	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	1¾%	..	3⅜— 4¼	3⅜— 4¼	4	3⅞
80,000	Urban Electric Supply, Ord.	5	..	..	..	4½— 5	4⅜— 5	4⅝	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4½— 5⅛	4½— 5⅛	4⅝	..
110,000	Westminster Electric Supply, Ord.	5	10¾%	12 %	13½%	12⅞— 13¼	12⅞— 13⅛	13⅛	..
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅜	6 — 6⅜	6	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, February 10th.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£90	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon ..	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£23	30/- inc.
a	Lead, Nitrate	per ton	£24	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	3d.	..
a	,, Caustic (75/80%)..	per ton	£24	..
a	,, Bisulphate	per ton	£35	..
a	Shellac	per cwt.	220/-	6/- dec.
a	Sulphate of Magnesia ..	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	,, Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£43 to £130	..
c	Brass (rolled metal 2' to 12') basis	per lb.	6¾d.	¼d. dec.
c	,, Tube (brazed)	per lb.	8¾d.	¼d. dec.
c	,, ,, (solid drawn).. ..	per lb.	7½d.	¼d. dec.
c	,, Wire, basis..	per lb.	7d.	¼d. dec.
c	Copper Tubes (brazed)	per lb.	9½d.	¼d. dec.
c	,, ,, (solid drawn) ..	per lb.	9¼d.	¼d. dec.
g	Copper Bars (best selected ..	per ton	£70	£3 dec.

	METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£70	£3 dec.
g	,, Rod	per ton	£70	£3 dec.
e	,, (Electrolytic) Bars ..	per ton	£63	..
e	,, ,, Sheets ..	per ton	£78	..
e	,, ,, Rod ..	per ton	£75	..
e	,, ,, H.C. Wire	per lb.	7¾d.	..
f	Ebonite Rod	per lb.	9/8	..
f	,, Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine ..	per lb.	4/4½ to 4/5½	inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	42/7	½d. inc.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£12	7/6 to 10/- in.
g	,, ,, Sheet	per ton	£13	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 5	..
d	Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d	,, ,, ,, medium	per lb.	2/6 to 3/9	..
d	,, ,, ,, large ..	per lb.	4/- to 7/9	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/- to 1/8	..
p	,, ,, strip & sheet	per lb.	From 1/1	..
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	9d. to 11d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£127 to £128	£1 dec.
g	,, Foil	per lb.	1/6	..
n	,, Wire, Nos. 1 to 16	per lb.	1/7½	..
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 les. Flax	per lb.	5⅞d.	..
j	,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS

	Locality.	Week ending	Receipts for the week.		No. wks.	Total to date.		Miles open.	
			£	£*		£	£*		*
	Aberdeen	Feb. 6	1,073	+300	36	44,122	+ 8,568	10	—
	Birmingham ..	,, 6	5,499	+273	6	30,641	+ 2,166	3½	—
	Bournemouth ..	,, 3	847	—	—	—	—	10½	—
	Blackburn	,, 5	771	+109	—	38,049	+ 1,707	13½	—
	Blackpool	—	—	—	—	—	—	8½	—
	,, —Fleetw'd	,, 6	219	+ 30	6	1,009	— 14	7½	—
	,, —Lytham	,, 4	156	—	14	2,030	+ 1,451	7½	—
	Bolton	,, 7	1,615	+ 81	45	81,998	+ 8,874	25	—
	Bradford	,, 7	3,483	+ 801	43	168,230	+22,110	45	—
	Brighton	,, 7	763	+ 36	—	40,636	—	7½	—
	Bristol	,, 5	4,895	+116	—	—	—	28	—
Co.	Devonport ..	Jan. 29	441	+ 84	4	1,909	+ 317	5	—
Trac.	Dudley—Sto'rb'ge	,, 29	718	+ 33	4	2,910	+ 135	18½	—
Elec.	Gateshead ..	,, 29	852	+ 86	4	3,544	+ 165	10½	+ ⅜
	Gr'n'k—Pt. Glsgw	,, 29	458	+ 98	4	1,924	+ 270	7½	—
	Hartlepool ..	,, 29	288	+ 29	4	1,011	+ 137	6½	+2
	Middleton	,, 29	233	+ 18	4	979	+ 20	8½	—
	Oldham—Ashton	,, 29	486	— 29	4	1,997	— 160	8	—
	Potteries	,, 29	1,575	+ 92	4	6,438	+ 225	28½	—
	Southport ..	,, 29	249	+ 25	4	965	+ 92	5½	—
British	South Staffs. ..	,, 29	784	+122	4	2,947	+ 245	21½	—
	Swansea	,, 29	475	+ 53	4	1,875	- 39	5½	—
	Wolverhampton ..	,, 29	836	— 19	4	1,810	— 42	10½	+3
	Yorks. Wool Dist.	,, 29	485	—	4	2,095	—	6	—
	Miscellaneous ..	,, 29	1,178	—	4	4,929	—	—	—
	Burnley	Feb. 6	886	+182	—	—	—	7½	—
	Burton-on-Trent ..	,, 7	297	—	27	9,424	—	8½	—
	Cardiff	Jan. 30	1,811	+250	—	85,995	+21,891	1	—
	Chatham & District	Feb. 4	518	+128	5	2,494	+ 551	8·63	—

* Compared with the corresponding period of 1903.

	Locality.	Week ending	Receipts for the week.		No. wks.	Total to date.		Miles open.	
			£	£*		£	£*		*
	Cork	Feb. 4	396	+ 24	5	1,991	+ 53	9	—
	Dover	,, 7	165	— 3	5	894	— 48	3	—
	Dublin	,, 5	4,381	+100	6	22,450	+ 858	47	+ ½
	East Ham	,, 6	577	+ 68	—	29,688	+ 8,107	5	+ ½
	Glasgow	,, 6	13,140	+1119	36	491,896	+52,050	69½	+½
	Halifax (2 weeks) ..	Jan. 27	2,160	+283	43	57,986	+ 6,182	31½	+½
	Huddersfield ..	Feb. 6	1,074	+106	—	—	—	—	—
	Hull	,, 6	2,004	+342	45	85,660	+ 6,439	18	+2
	Ilkeston	,, 3	120	—	—	—	—	3½	—
	Ipswich	,, 6	311	—	—	3,224	—	9	—
	Isle of Thanet ..	,, 6	215	— 5	5	1,051	— 57	10½	—
	Leeds	,, 6	4,798	+150	—	245,196	+15,263	41	—
	Liverpool	Jan. 30	9,334	+ 166	5	47,740	+ 2,164	103	—
	London C. C. ..	,, 30	8,848	+ 782	43½	429,983	+76,5 7	39½	—
	Manchester	Feb. 6	10,692	+2703	—	520,474	+276,378	72	—
	Newcastle	,, 6	3,589	+557	—	—	—	17	—
	Portsmouth	,, 6	1,391	+161	—	77,987	+ 4,853	14½	—
	Salford	,, 8	3,638	+805	—	171,608	+ 48,144	30	—
	Sheffield	,, 7	4,201	+278	45½	206,063	+17,425	32½	+½
	Southampton ..	Dec. 17	844	+ 17	—	—	—	16½	—
	Southend-on-Sea ..	Feb. 3	190	+ 9	44	13,976	+ 2,164	8	—
	Sunderland	,, 7	1,074	+104	45	54,366	+ 2,541	20	+3
	Tyneside	,, 3	283	+ 60	5	1,311	+ 318	8·9	+ ·43
	Wolverhampton ..	,, 7	391	+ 9	—	—	—	5½	—
	Cen. London Rly. ..	,, 6	6,994	— 44	6	41,788	+ 74	6	—
	City & S. Lon. Rly.	,, 7	3,239	+ 26	6	19,288	— 917	6½	—
	Dublin—Lucan Rly.	,, 7	103	+ 9	6	508	+ 33	6½	—
	L'pool Overh'd Rly.	,, 7	1,532	— 68	6	9,264	+ 355	6½	—
	Mersey Railway ..	,, 6	1,481	+399	5	7,213	+ 1,865	4½	—

PROGRESS IN ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY IN 1903.

By JOHN B. C. KERSHAW, F.I.C.

(*Concluded from page* 244.)

Calcium Carbide.—The calcium carbide industry in Europe is gradually settling down, after the disasters of its early years, to the more normal conditions of supply and demand; and the year 1903 has been marked by an extension of the system of central bureaus for regulation of the output and price in the various countries.

France and Switzerland are the two countries which have suffered most in the general restriction of production which has followed the years of "boom" (1897-1900), and in the south-eastern districts of France many of the shut-down carbide plants are now being converted into central light and power stations.

In England, only two companies are now believed to be producing carbide—namely, the British Aluminium Co. at Foyers, and the Acetylene Gas and Electric Smelting Co., at Ingleton, Lancs.

In France, the manufacture of carbide is controlled by the Société des Carbures Metalliques, which owns the Bullier patents for carbide production, and this company has centralised the manufacture in a few of the better equipped factories, and has shut down the remainder.

In Germany, the home manufacture of carbide has declined to very small limits, owing to the competition of the factories situated in Switzerland, Austria and Norway. A revival is expected under the new tariff regulations, which fix an import duty of 6 fr. per 100 kgs. on this product, and it is hoped that the home consumption, amounting now to over 14,000 tons per annum, will be met entirely by the German works.

A new factory is planned at Zwickau, in Bavaria, drawing 2,000 H.P. from the Wolfsteiner Falls, on the River Ohe.

In Switzerland the carbide industry is likely to decline, owing to the growth of the manufacture in Germany, Italy and Austria, and in time it would seem probable that Switzerland will supply only its home demand for carbide. The exports of Swiss carbide amounted to 58,844 centners, and were valued at 1,708,000 fr. in 1902.

In Italy the carbide industry is developing, and the home production is reported to have grown from 250 tons in 1897 to 4,800 tons in 1902.

In America the Union Carbide Co., of Niagara Falls, owns the Wilson patents, and controls the output, but two smaller works at St. Catherines and at Ottawa, in Canada, are producing carbide under independent licenses. It is noteworthy that although the validity of the Wilson patent for carbide production has been successfully contested in the United Kingdom, no legal proceedings have yet occurred in connection with the Wilson patents in America.

The price of carbide in Germany varies from 24 to 26 marks per 100 kgs., while in the United Kingdom the latest prices are from 14s. to 16s. per cwt., according to the distance of the depôts from the factory at Foyers.

As regards acetylene illumination, Germany can show the most progress, and according to Vogel, 55 central lighting installations of acetylene gas are now in existence in that country. The price for the gas delivered to the consumers varies from 33/10 to 58/4 per 1,000 cb. ft.

A mixture of oil gas and acetylene is also extensively used on the German State railways, and in a recent report upon this method of illumination, it is stated that 18,000,00 cb. ft. of these gases are now being consumed for railway lighting per annum.

Chlorates.—The electrolytic chlorate industry has not shown any expansion during 1903, and owing to the low prices which potassium and sodium chlorate now command in the market, no new factories are being erected for the manufacture of these products.

The works of Corbin & Cie., at Chedde, in the Hte. Savoie, remain the largest producers of chlorates.

According to Hart, the works of the North American Alkalki Co., at Bay City, where the Hurter cell and process is operated, have not achieved any commercially important results. In France the industry is also stated to be in a stationary position, and the Société d' Electrochimie and the Société des Forces Motrices de l'Arve are the only producers of electrolytic chlorate. The works at St. Gobain and at Salindrés, continue to manufacture this chemical by the old Liebig process.

Copper.—The electrolytic copper industry in the U.S.A., continues to expand at the expense of the development of the same industry in other countries, and according to Titus Ulke, the relative production ratios of the electrolytic refineries situated in the various countries are now as follows:—

U.S.A.	...	86·5 %	United Kingdom	...	8·8 %
Germany	...	2·75 %	France	...	1·6 %

The chief recent improvement in the refining process is the use of anodes double the thickness of those formerly employed. This, of course, reduces the labour charges per pound of deposited copper. Bancroft, in a recent paper on the theory of the refining process, has urged the advantages of working with covered tanks, but the opinion of practical men in the States seems to be, that the saving in current, due to the higher temperature of the electrolyte, would be swallowed up in increased working and maintenance charges.

Interesting trials with a method of direct smelting of Chilian ores in the electric furnace have been carried out in France during the past year, and the results obtained have led to proposals to erect an electric smelting plant in Chili, where water-power is cheap.

Cyanides.—A patent has been taken out by a German company for a process for producing calcium cyanamide in the electric furnace, which may have an important future. A mixture of lime and coke is heated in an electric furnace to 2,000° C., and nitrogen or air is passed over the mixture. Nitrogen is absorbed, and calcium cyanamide is produced. This product may be used for the manufacture of potassium cyanide, by double decomposition with a potassium salt. It is also stated to be of value as a manure, and, under the name of "Kalkstickstoff," it is already being sold for this purpose in Germany.

Hypochlorites.—There is little that is new to report concerning the progress of this industry during 1903. Hart, in his report upon the position of the alkali and bleach industry in U.S.A., however, gives some new facts relating to the use of hypochlorites in paper and pulp mills in that country, and states that the Moore, Carmichael and Le Seuer cells are in use. At Berlin Falls, N.Y., the Moore cell is employed, while the Warren Paper Pulp Co., at Yarmouth, use the Carmichael cell and process. Hart gives efficiency and costs figures for the Carmichael process, but lack of space will not permit reproduction of these. With bleach selling at $12 per ton, Hart considers that the electrolytic hypochlorite processes can be made to pay. The writer has recently described two new forms of hypochlorite cell in these columns, and has given efficiency figures for the older forms of cell.*

Iron and Steel.—The numerous experimental trials of the electric furnace for iron and steel production, which have been occurring in France, Italy and Sweden in recent years, have led at last to remunerative results, and tool steel produced from pig-iron and scrap-steel in the Heroult and Keller types of furnace, is now being placed on the market in large amounts in France. According to Heroult, 2,500 tons of this steel have been already produced in France, and by the end of the present year, plant with a capacity of 400 tons of steel per day, will be in operation.

The electric refining of iron would, therefore, appear to be an industrial success, and the steel produced in the electric furnace is evidently able to compete, both as regards properties and price, with steel produced by the Martin and open-hearth processes.

The Heroult and Keller electric refining furnaces are similar in principle and design. The electric current is led into, and away from, the furnace by massive carbon poles, and the heating of the metal is entirely effected by the arcs which are formed between the surface of the metal and these two poles. Suitable materials are used to form slags with the impurities of the raw iron, and when requisite, two or three "washings" with different molten slags can be carried out

* Electrical Review, December 25th, 1903.

in the furnace, before the charge of fine steel is run out or tipped into the ingot moulds.

Special alloys of iron can also be easily made in this type of furnace. The Heroult furnace is in active operation at La Praz, while the Keller furnace is in use at Livet, on the Romanche.

The Kjellin electric steel process is another, which depends upon the use of pig-iron or scrap, as raw material; but in this case induced currents are employed to effect the heating of the charge of metal. This furnace and process are at work at Gysinge, in Sweden, and, according to the reports which have been published, the Kjellin process and furnace can be operated to yield a profit in that country. Extensions of the original experimental plant are therefore to be made.

The Stassano, Conley and Harmet furnaces and processes do not appear to have made progress during 1903; and, as all start from the ore as raw material, and compete with the ordinary blast-furnace procedure, the writer is not inclined to prophecy any important industrial developments for these processes and patents.

The Ruthenberg process, which is merely an ore-concentrating process, has made some progress in America during the year, and a syndicate of Canadian capitalists is reported to be about to give a trial to the process on a large industrial scale at Niagara Falls. The ore utilised for the Ruthenberg process is low-grade magnetic ore containing much gangue, sulphur and phosphorus, and the treatment between the magnetic rolls is said to remove the larger proportion of these impurities.

Nitric Acid and Nitrates.—The experimental trials at Niagara Falls with the Bradley and Lovejoy process for fixing the nitrogen of the air by high-tension electric discharges, have continued through 1903. The Atmospheric Product Co. is the name of the company exploiting the new process at Niagara, and the plant erected for trial of the process absorbs 45 KW. electrical energy. According to Prof. Haber, who visited this plant early in 1903, the process is still in its experimental stage, and its future success is still problematical. The difficulty appears to be that the liquid acid produced is weak, and that the costs of concentrating it and obtaining a commercial product, will prove prohibitive. Volney, an American critic, has also stated his belief that all processes of this kind are doomed to failure, since the electric spark decomposes the nitrogen oxides already formed, and the process is a reversible one. In view of these criticisms, it is interesting to note that the Société de l'Acide Nitrique are making trials with a similar process at Fribourg, in Switzerland. The output is stated to be from 52 to 55 grammes HNO_3 per kilowatt-hour, when air is employed in the sparking apparatus. The process employed is believed to be that of Kowalski and Moscicki, protected in this country by Patent No. 20,497, of 1903.

Nickel.—The year 1903 has not been marked by any notable expansion or progress in the electrolytic nickel industry. The Hoepfner process, with some modifications, is still operated at Papenburg, in Germany, but it is doubtful if the process has proved so successful as was at one time expected, and no developments of the same process elsewhere are heard of. The Browne process has been worked for some years at Cleveland, U.S.A., and according to Haber 454 kgs. nickel per day have been produced by it. The plant at Cleveland has, however, recently been shut down by order of the Nickel Trust, and since nickel testing 99·2 per cent. purity can now be produced by the ordinary metallurgical process, there does not appear to be much room for the successful exploitation of a nickel electrolytic refining process in U.S.A.

Ozone.—Considerable interest has been aroused during 1903 in the industrial application of ozone produced by electrostatic methods, by the publication of details relating to two ozone water-purification plants erected by Siemens and Halske, at Schierstein, and at Paderborn in Germany. These are the first works of this kind operated on a commercial scale in Germany, and according to the reports of the engineers, the results obtained are quite satisfactory. Some trouble has, however, been caused at one of these works, by the presence of iron in the water, and the writer is not certain that this has been overcome; since at the Berlin Chemical Congress in June, 1903, the plant was stated to have been shut down. In Holland, experimental trials of the Vosmaer-Lebret ozoniser are being made for water purification, and an installation of this apparatus at Rotterdam is contemplated. In France, the Marmier and Abraham ozoniser and process are in use at Lille and Marseilles. Experimental trials with a similar apparatus have been conducted for some time by the East London Water Co. at Lea Bridge, in England; but no details of the results obtained there, have yet been made public. In America, Otto has been conducting experimental trials of his latest form of ozoniser for sterilisation purposes at Niagara Falls, but no actual installation of ozone water-purification plant upon a commercial scale has yet occurred in that country.

Tin.—The electrolytic methods of recovering tin from tin-scrap are making progress, and there are now reported to be seven factories in Germany, three in England, and one in Austria engaged in this industry. The German factories are stated to be dealing with 30,000 tons of scrap annually, and since Germany does not produce this amount of scrap, the deficiency of raw material for the process is being drawn partly from Switzerland and partly from England. The electrolyte usually employed in these factories is a 10 per cent. solution of sodium hydrate, and in some cases sodium chloride is added to intensify its corrosive effect.

As regards electrolytic methods of tin extraction, the Böhne process is stated to be in operation at Tostedt, Germany. This process depends upon the grinding of the raw material to a fine powder, and its extraction with sulphuric acid. The solution obtained is then electrolysed, using tin-iron anodes and cathodes of pure tin. The process is reported to be successful, and extensions of the original plant have been made.

Zinc.—The Swinburne and Ashcroft process continues to be tried experimentally at the Castner-Kellner works at Weston Point, but no information as to the actual output of zinc by this process, is yet available for publication.

The Hoepfner process is also operated at Messrs. Brunner Mond & Co.'s Winnington Works, and plant equivalent to 3 tons zinc and 9 tons bleach per day is reported to have been erected. Up to April 30th, 1901, 1,660 tons of zinc and 5,000 tons of bleach are stated to have been produced by the Hoepfner process at Winnington. The fall in the value of bleach, which occurred early in 1903, will, however, have had its effect upon the output of zinc and chlorine by this works.

The Salgués process, which depends upon the smelting of zinc ores in the electric furnace with fluxes which carry off the whole of the impurities, is being tried at Crampagna, in the French Pyrenees. The process is said to yield 5 kgs. Zn. per KW.-day.

Two new electric-furnace processes for the treatment of zinc ores, are also receiving trial in Sweden and Norway, but few reliable details concerning these have been published.

As regards the electro-deposition of zinc upon iron, Strzoda and Graban have published interesting communications during 1903, but limits of space forbid any detailed reference to the results obtained by these investigators.

ROYAL COMMISSION ON LONDON TRAFFIC.

At the sitting of this Commission on Thursday last week Mr. C. S. Meik, M.Inst.C.E., gave evidence. He said that his evidence had been prepared in conjunction with Mr. Walter Beer. The London traffic problem might be divided into two heads:—Relief of congestion of vehicular traffic, and the transport of passengers between the outskirts and the central business area and through that area. He considered that the provision of two great arterial thoroughfares running respectively from north to south and from east to west was of the first importance. Witness then handed in plans and sections of the proposed thoroughfares which he called "main avenues," and described them at some length. The provision of a road to be exclusively reserved for motor traffic he regarded as a necessity. In the course of further evidence, witness said that the relative costs of construction in connection with the main avenues, exclusive of equipment, would be as follows:—Suspended railway, £75,000 per mile; shallow subway, £250,000 per mile; and tubes, £350,000. The cost of the Elberfeld-Barmen overhead line was £46,000 per mile, exclusive of equipment, and the actual tender for the proposed Hamburg suspended railway amounted to about £70,000 per mile. In the case of a new main avenue, the cost of the foundations for a suspended line would be small, and he had excluded that item. Apart from the cost of working lifts, the working expenses and maintenance of the three types of railway would be about the same; the actual working costs of the suspended rail-

way would be lower, on account of the lighter rolling stock and consequent saving in power and the saving in lighting, but the structure would be more expensive to maintain, except as regards permanent way, in connection with which there would be a considerable saving. The cost of pumping in the case of a subway might be considerable. Witness went on to deal with the appearances of all three types, and dealt with the cost of the main avenue proposals and other financial aspects of the scheme, and the Commission adjourned.

At the sitting on Friday, evidence was given by Sir Ralph Littler, K.C., chairman of the Middlesex County Council, who said that many complaints had been made as to the width of the main roads in the county traversed by the tramways of the London United Tramways Co., Ltd., and he was of opinion that a series of through main roads should be constructed through the county at the national expense to provide for the necessary through traffic. After very careful consideration, the County Council of Middlesex had come to the conclusion that the Light Railway Commissioners are not a satisfactory tribunal to deal with applications in Middlesex, and that it would be better if all schemes were referred to Parliament. No tribunal, other than Parliament, gave satisfaction, or, in his opinion, could do so. The Light Railway Commission, in respect of the operation of the Lands Clauses Act, was a hardship on promoters. The County Council had tried to arrange for the adoption of a scheme for the interchange of traffic with the L.C.C., but no arrangement had yet been come to. The main thoroughfares of Middlesex, and the lines of railway and tramway, chiefly radiate from the central positions in London into the adjoining counties, like the spokes of a wheel, but there was no road or railway analogous to the tire of a wheel to give communication to the outer end of the spokes. An anomalous state of affairs, therefore, existed. He certainly thought in all cases the County Council should be the tramway authority, and the only authority, to buy up tramways.

Mr. J. E. Waller, M.I.C.E., said he had had some 20 years' experience in connection with tramway undertakings, and in his opinion the construction of tramways must play a considerable part in solving the problem of London traffic. He did not think that tramways should be permitted in streets where there was not sufficient width to provide for at least one line of vehicles alongside the kerbs without encroaching on the space required by the tramways. This meant that a double line of tramway could only be laid in streets having a minimum road width of 30, or a single line of tramway in a street having a minimum road width of 22 ft. He did not think that even in narrow streets, subject to the limitations he had mentioned, tramways should impede or delay the ordinary vehicular traffic, and certainly not to the extent to which it was now impeded by omnibuses. The ultimate result of the introduction of tramways in the London streets would be, to a large extent, to organise and regulate the traffic, and to enable a greater volume of traffic to be dealt with. He did not think that tube railways could serve the public in the same way that tramways could, and the enormous capital involved in tube railway construction was against their extensive development. Generally speaking, in his opinion a comprehensive system of tramways could be constructed in London without adding to the congestion of the streets. In some streets, such as Lombard Street, for instance, he could hardly advocate surface tramways, and the continuity of the system would have to be provided for by the construction of shallow subways. If tramways were to be constructed so as to efficiently meet the requirements of the travelling public, it was essential that through services should be run, extending in all directions through London, and even extending beyond the limits of the county. He had considered how best this difficulty could be met. On the one hand, there was the objection to independent undertakings, and, on the other hand, a scheme of tramways sufficient to meet the requirements of the metropolis would be so extensive as to be apparently too great to be undertaken by any one Corporation or company. He was of opinion, therefore, that on broad lines the only satisfactory way to deal with the matter would be to allow road authorities or companies to promote tramway undertakings, regard being had when sanctioning such undertakings, to their suitability as forming part of a general scheme for the Metropolis, such general scheme being, in its broad outlines at any rate, present to the minds of the legislative body. He did not consider it was a practical suggestion that either the Board, or some independent body, should initiate a scheme of tramways for London. Even assuming that after an enormous amount of investigation and expense a complete scheme was decided on, it seemed to him that it would be an impractical thing to suggest to the public at large that they should promote schemes on the lines so laid down. One of two results would arise. Either promoters would be chary of coming forward to seek authority for cut-and-dried powers, or else, if they did come forward, there might be a number of applicants for some of the lines and no applicants for others, as obviously every promoter would desire to obtain the most remunerative of the schemes, and the undertaking, as a whole, would be of too great magnitude for any one promoter to proceed with. The right of working the tramways should be distinct from the right to construct and maintain, and the authority having control of the tramway traffic of the Metropolis should be entitled to grant running powers to the company or body owning any one system over the lines of another owner. The terms and conditions on which such running powers should be exercised, the service of cars to be run, and other matters affecting the conduct of the traffic, should be under the control of the tramway authority.

Witness was questioned on the matter of a suitable tribunal, and dealt with the three present modes of obtaining powers for the construction of tramways. Each of these he said had its advantages and disadvantages, and the inconsistencies of the three methods were a source of much inconvenience. He dealt at considerable length with the objection to the present methods, and thought that relief should be given both to local authorities and to company promoters. As regarded both parties, there should be no absolute frontagers' veto; and, as regarded local authorities, there should be no ratepayers' veto; and, as regarded company promoters, there should be no road authority veto, and the right to promote tramway undertakings and to be tramway authority should be extended to all County Councils. The only satisfactory way to deal with the tramway legislative problem, whether applied to London or the whole of the county, was the creation of a special tramway or street traffic board.

The witness had not concluded his evidence when the Commission adjourned.

ELECTRIC OVERHEAD TRAVELLERS IN CENTRAL STATIONS.

[COMMUNICATED.]

A recent article by Mr. E. Kilburn Scott on the above subject, made a strong plea for the more general use of electricity as the motive power for overhead travelling cranes in central stations, and attributed an abject slavery to fashion, as the cause of the prevalence of the simpler type adapted for man labour. There is, however, a deal to be said on the other side, as the present article endeavours to show.

In the first place, as Mr. Scott truly says, the initial cost is the chief drawback of the electric crane, though by no means the only one. A three-motor crane with a span of 40 to 50 ft., and capable of lifting 7½ tons (suitable for a station of 1,250 kw. or so) will cost from £600 to £800 all told, as against £225 to £250 for the hand traveller of similar capabilities. In one case the writer knows, tenders were invited for electric travellers of about this capacity, and prices came in ranging around £650; but one firm had the forethought to submit an alternative tender for a hand-worked crane, and with this got the order at just 30 per cent. of its electrical quotation.

An additional expenditure of £400 to £500 is well invested if it will return, say, 10 per cent. per annum. But where is this to come from in a central station? Once the machinery is erected, the traveller is seldom used, except, perhaps, to lift in a barrel of oil, or for some similar purpose where its assistance might almost as easily be dispensed with; and its prime use is as a stand-by for pulling the machinery to pieces in case of a breakdown. Its service throughout the year upon station work will not average one hour per day, so that, supposing the electric crane were to save the work of one man the whole of the time that it is in operation, the labour dispensed with, at 6d. per hour, would amount to but £9 per annum. But the electric crane will save nothing like this amount of labour, if indeed any, as allowance must be made for the fact that it will need regular attendance to see that the contacts are bright, the insulation good, and the whole in working order. Moreover, it will probably be worked from a cage, in which case the entire services of one man—and that one not a raw labourer—will be taken up in driving it during the whole time that it is in commission; while, even if it is worked from the ground by means of ropes—a method which several makers absolutely refuse to adopt—their manipulation will take more attention, though less manual labour, than the chains of the hand-worked traveller; and, be it noted, we have here the dangling ropes which constitute one of Mr. Scott's charges against the simpler machine.

The first great use of a traveller of any kind is in putting the machinery in position when the station is in course of erection; and is not here the advantage largely on the side of hand working? The case cited, where a contractor supplied an electric crane, although only paid for a hand traveller, owing to its assistance to him in erecting his plant, could only have occurred in very exceptional circumstances; for, most unfortunately, as long as the bed-plate is the only part of a generating set on site, and the rest of its component portions are at the maker's works, or in the hands of the railway company, it is incapable of producing electricity, and yet this is the state of affairs when the traveller begins to be really a necessity. It is only on the largest jobs that it could pay a contractor to provide a special electrical plant for use during the constructional work of the station, and even then it will probably be better economy on his part to put his money into a self-contained steam jib crane, which is bound to be available everywhere, rather than a portable central electric station, which may some day encounter an overhead electric traveller which it is capable of driving.

In building an extension of an existing station, or in adding fresh machinery to one already at work, this does not apply, and here the electric traveller will be really useful. Yet few station engineers would hand over the free use of their electric crane to the erectors—chiefly unskilled labourers—of their contractors. The lending of their crane probably means the lending of a man to drive it, and if the availability of an electric crane has been mentioned in the specifications, the contractor may be sure to kick at the suggestion of paying either for the use of this man's time or for the current he uses—he would far rather have free control over the crane to run it as hard as he wished. On the other hand, there is no danger in lending him the hand-worked crane, as he cannot do much damage to it, and any injury done will in most cases be readily visible, and can be charged to him. Hence it is very doubtful if the central station will get any benefit from the small reduction in price the contractor may make in his tender through knowing that he will have the use of an electric traveller in the erection of his plant.

Where else are Mr. Scott's claimed advantages? "Slowness of the hand traveller in cases of emergency" is a true indictment no doubt, but if slow, it is at any rate sure. The electric crane, on the other hand, by any severe catastrophe which shuts down the whole station—*e.g.*, a burst steam pipe—will be thrown *hors de combat* unless provided with the much despised hand gear for alternative use.

The best point Mr. Scott makes is the value of the crane for show purposes; but regarded as an advertisement, is it much better than a motor driving the economiser scrapers? A manufacturer who could think seriously of spending £500 on an electric traveller has assuredly got plenty of machinery in his shops, and he will probably commence experimenting with electric driving upon something of less importance and less costly than his cranes. And it is well for the supply that he should, since a 10-H.P. motor driving line shafting will mean a much larger consumption of power per annum than will 30 H.P. on a traveller.

Finally, although in a manufacturing shop where the crane is in constant requisition, an electric traveller will usually be found to be true economy, yet for central station requirements it seems very doubtful if the great expense of this can in any way be justified, except in a case where the horse-power of the station is measured in thousands, and where the units are large.

LIGHTNING AT CLOSE QUARTERS.

By FRED. H. HADFIELD, M.I.E.E.

POSSIBLY many others of our profession, readers of this, may have seen or experienced the awe-inspiring effects of lightning at close quarters; for myself, I have done so too often for my peace of mind, and in that country where its effects seem most marked—South Africa.

I have had the opportunity of seeing there, close to the Berg, the mountain range between Natal, and what used to be the Free State, the sky turn to a ghostly greenish hue, the wind rise in the space of a few minutes to a shrieking hurricane, almost overturning the post cart, and the thunder roar apparently in your very ears, while the lightning struck the ground and sent the boulders flying—a veritable inferno; while a short distance off it struck the trek chain of an ox wagon, killing every unfortunate beast.

And I have been nearer than this. Some years ago I had occasion to be working in a shop where I had a small steam engine running a dynamo and a line of shafting driving machine tools. As I wanted all the available power on the shafting, I went up to the roof to disconnect the coupling joining the two halves of the shafting, sitting on a plank while I took out the bolts. I had casually noticed that there was a storm about, but did not connect it with my present job. I had just finished disconnecting, and had levered back the coupling a couple of inches, sitting with my knees not 6 in. away, when, with a deafening noise, a most appalling flash passed across the gap between the coupling; the roar of the thunder, the noise of the falling iron chimney, the yells of some natives outside, and the sort of phosphoric stench one always gets on these occasions, came all together. I am not a particularly nervous subject at any time, and have been in peril of my life quite a dozen times, but nothing has so completely demoralised me as that flash. I absolutely had not the control of my muscles for some moments to remove myself from further danger.

I found the discharge had struck the iron chimney, riddling it with holes and knocking off the top length, gone through the iron roof, jumped thence to a large pulley, arced over the gap between the halves of the coupling, along the shafting, thence to a 400-gallon iron tank outside full of water, and to earth through the water main.

On another occasion, many years ago, I had been inspecting a telephone, and a bad storm came on. I have found it convenient on these occasions to leave telephones alone, so I sat outside on the verandah watching the storm. The earth wire from the instrument was of stranded iron, and came out under the verandah and took a right-angled turn before going to earth. This was about 6 ft. from me. Suddenly the lightning struck the iron rod on the roof carrying the insulator, demolished the telephone, and I saw carried out before my eyes the well-known law that a high tension, or static, discharge, rather than "turn a corner," will prefer the path, apparently, of *greater resistance*. In this instance it discharged across more than 40 in. of air space sooner than take the right angle!

On another occasion, in my own house, I saw what I believe is a most unusual thing, that is, the fact of two succeeding discharges striking the same object. It was another very bad storm, and the sky was on this occasion quite green. The first flash struck the telephone, and I saw the light of the burning metal between the edges or chinks of the case. Almost instantly a second discharge struck it, blowing off the door and melting things up generally.

What I hope may make these remarks interesting to the "stay-at-homes" is the fact that in England one does not get the opportunity of observing these intense effects, or at such frequent intervals as in South Africa, thus preventing them from studying these most interesting phenomena. For instance, it is intensely interesting to watch during a storm the discharges to earth through the Thomson magnetic blow-out arrester. I have fitted all the different patterns. I may say here that I do not believe that any arrester exists that will arrest at all times in our country, but the above are the best I know. You will see at times, for no apparent reason, that the flash and its consequent blow-out are instantaneous, too quick to follow; while at other times you may distinctly see the arc go up the horns until it breaks—blown out. Of course, on all occasions the dynamo current may not follow the lightning discharge and be thus switched back again, as it were, but too many things happen at once on these occasions, and one cannot follow them all.

Another instructive object lesson I once appreciated. Some years ago there stood outside the Court House at Durban, Natal, a high flagstaff with top mast. Steel wire ropes were carried down from the cross-trees to within 6 ft. or 8 ft. of the ground, where they were foolishly joined to the anchor plates by intervening rope lanyards. I saw the lightning strike this. Of course, it could only pass to earth over the wet ropes, and the result was an awful smash up.

Last, but not by any means least, I may add the following. I came home in 1889 principally to see the Paris Exhibition, and on my return voyage in November of that year, our vessel ran into the most awful storm it has been my fate to experience at sea. It commenced before we rounded Ushant, did its worst in the Bay, and followed us for eight days. At its height I saw then for the first, and I earnestly hope for the last time, luminous balls of fire on each masthead—St. Elmo's fire, so called. The marvellous grandeur of such a storm one cannot dispute, in spite of physical discomfort; the inky blackness of water and sky, the white flying spindrift, the labouring vessel wallowing in the waves coming in hundreds of tons over her bows, in spite of her engines running only quarter speed, the howling hurricane and almost continuous lightning, and calmly sitting above all this disturbance these mystifying luminous spheres. Whatever they may be or how produced, it seems to me that the old seaman shaking his head at them is as wise or as ignorant as the rest of us. On this occasion and others I should have revelled in the companionship of the crank who so constantly rams it down the throats of the reading public that no waves ever exceed 40 ft. in height. I am inclined in my vanity to think that the gentleman in question has not made the acquaintance of a genuine cyclone. A real number one grade cyclone I had the pleasure of sampling blew down the registering anemometer after it had recorded a speed of some 90 miles per hour, thus leaving the calculation of its eventual speed to the imagination. It held the writer in the angle of a building as fast as if he had been nailed, while the neighbouring trees and iron roofs "went by the board." The sea came up on the land, verandahs, iron roofs and house fronts were swept away, and a warehouse belonging to a shipping firm collapsed like a house of cards—walls, roof, woodwork and contents in a heap. Most of the lightning display on this occasion occurred within the electric lighting station, which fed a lot of overhead mains, which were swept away lock, stock and barrel, while the engineer in charge endeavoured to shut down engines and switch off circuits with feet as well as hands, and wished for the nonce he had been endowed like the centipede.

INSTITUTION OF ELECTRICAL ENGINEERS.

THREE-PHASE WORKING, WITH SPECIAL REFERENCE TO THE DUBLIN SYSTEM.

By WM. BREW.

(*Abstract of Paper read at Dublin, January 14th, 1904.*)

Generating Plant.—The three-phase generator is essentially suitable for power transmission. Its prime cost and weight are usually about 30 per cent. less than a single-phase machine of the same output, whilst with star winding and earthed neutral point the pressure tending to break down the insulation of the machine is only 57 per cent. of that between the line wires transmitting the power. In three-phase transmission systems at extra high pressure the line voltage at which step-up transformers become advisable at the generating station is thus much higher (with resulting economy as regards plant and working losses) than would be the case if single-phase generators were used earthed at one pole in the usual manner.

It was urged at one time that generating direct at extra high pressure at the Pigeon House station, which is so near the sea, would be out of the question, and that step-up transformers would have to be employed. The 5,000-volt three-phase alternators have, however, been working continuously now for seven months without giving any intimation that the sea air disagreed with them. In the case of Dublin we have four star-wound Oerlikon generators, two of 1,000 KW. and two of 500 KW. output, driven direct by marine type compound engines with Corliss valve-gear. The principal data of these machines are as follows:—

	1,000-KW. sets.	500-KW. sets.
Speed, revolutions per minute	84	94
Number of magnet poles	72	64
Number of coils per phase	36	32
Weight of fly-wheels and magnets, in tons...	44	33
Diameter of wheels, in feet	18 3	14 2

There are six slots per pair of poles; we should thus expect to find harmonics of the fifth and seventh order in evidence upon the fundamental wave of 50 ~ per second under favourable circumstances. The electrical characteristics of these machines are illustrated by figs. 1 and 2. The curves marked A give the relation between exciting current and terminal pressure. The curves marked B give the short-circuit current of the machines for various values of the exciting current. The synchronous impedance of these machines, or the relation of the terminal volts on open circuit to short-circuit current at the same speed and excitation, can be read at once from these curves. It will be seen that the short-

circuit stator current with an excitation which would produce full terminal potential difference of 5,000 volts is in the case of the 500-KW. sets 148 amperes, and in the case of the 1,000-KW. sets 240

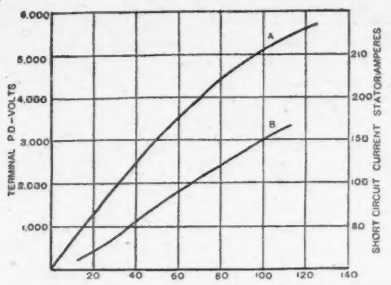


FIG. 2.—Dublin 500-kw. Generator, 3 Phase, 50~, 93·5 R.P.M.

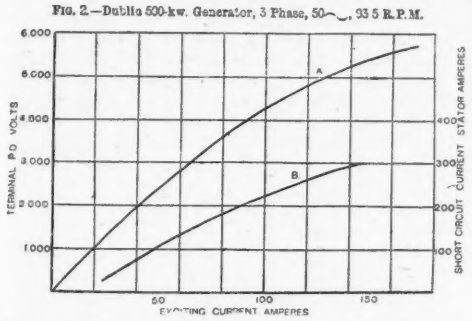


FIG. 1.—DUBLIN 1,000-KW. GENERATOR, 3-PHASE, 50 ~, 84 R.P.M.

amperes. These quantities are of importance in connection with calculations on resonance, and will be referred to later.

It is well known that the excitation of an alternator, necessary to maintain full terminal pressure, varies for the same armature current according to the power factor of the load. On open circuit, or with small armature current, the demagnetising effect of a lagging current, or magnetising effect of a leading current, upon the magnet poles will be inappreciable, and a rise in pressure will either indicate resonance or the neutralising of the armature self-induction by the capacity of the cable. The curve (fig. 3) is interesting in this respect, and shows how the exciting current necessary to maintain full terminal pressure of 5,000 volts on one of the small Dublin sets varies according to the length of three-core cable connected on open circuit. In this case the alternator is only supplying a charging current to the cable.

Trunk Mains.—Although plenty of data have been published regarding Continental overhead lines, the writer is not aware that tests of the impedance and charging currents, &c., of British power lines are much in evidence. The impedance of cored low-pressure distributor cables is of importance in the laying out of a three-phase distributing system.

The test of the impedance of 6·2 miles of ·15 three-core feeder given in Table I. may be of interest. The pressures, V_1 and V_2, across two phases of the cable and the currents, C_1 and C_2 in two of the cores were measured at the sending end, whilst all three cores were bunched at the other end. It will be seen from the tests that the impedance of this cable per mile = 0·324. The measured resistance per mile of core = ·282.

TABLE I.—TEST OF IMPEDANCE OF 6·2 MILES OF (THREE-CORE ·15) EXTRA HIGH-TENSION FEEDER AT 50 ~.

P.D. between phases at sending end.				Current per core at sending end.			Impedance per single core.
V_1	V_2	Mean.	Mean $\div \sqrt{3}$	C_1	C_2	Mean.	
89	88·5	88	51·2	26	25	25·5	2·01
90	90·5	90·5	52·2	26	25·5	25·75	2·03
99	99	99·5	57·2	28·5	28	28·25	2·02
108	108	108	62·5	31·5	31	31·25	2
116·5	116	116·5	67·2	34	33·5	33·75	1·99
119	119	118·5	68·6	34·2	34	34·1	2·01
						Mean =	2·01

Between the generating station at the Pigeon House Fort and the central distributing station at Fleet Street, a distance of 3·1 miles, three trunk mains have been laid. Each of these mains consists of a three-core, lead-covered British Insulated and Helsby Co.'s paper cable, the section of each core being ·15 sq. in.

Capacity tests made upon these feeders after they were laid gave the following results:—

High-Tension Feeders ·15 sq. in, Three-core Extra High-Tension Paper Cable, Lead Covered.—One core against two other cores bunched to lead sheath, ·303 mfd. per mile; three cores bunched against lead sheath, ·49 mfd. per mile.

·04 sq. in. Three-Core Extra High Tension Paper Cable Lead Covered.—The corresponding capacities of these cables per mile are: One core against two other cores bunched to lead sheath, ·25 mfd.; three cores bunched against lead sheath, ·46 mfd.

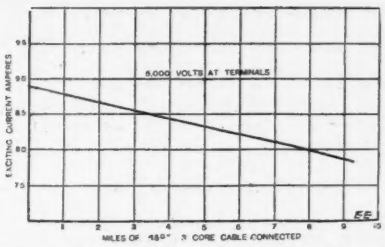


FIG. 3.—DUBLIN 500-KW. GENERATOR, 94 R.P.M.

The above capacities correspond to a Y capacity of ·373 mfd. per mile for the ·15 sq. in. three-core cable and ·298 mfd. per mile for the ·04 sq. in. three-core cable. The pressure charging these cable condensers is 2,880 volts, with 5,000 volts between phases. The minimum charging current per mile will, therefore, be for the ·15 sq. in. three-core = ·337 ampere, and for the ·04 sq. in. three-core = ·272 ampere. Resonance or deviation from the sine curve of E.M.F. may, however, considerably increase these values. In order to test this point experimentally, two phases of one of the

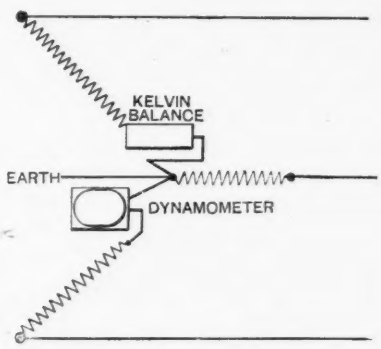


FIG. 4.

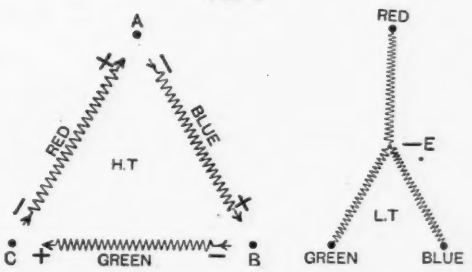


FIG. 5.

500-KW. sets were disconnected from the earthed neutral bar, and an electro-dynamometer and Kelvin balance were inserted between these phases and the neutral, as shown in fig. 4. With the generator coupled to two trunk feeders in series, the readings in Table II. were obtained. It will be noticed that the charging current per core considerably exceeds the theoretical minimum value. This current, however, includes leakage from two large switchboards, one at either end of the line, and newly erected.

TABLE II.—TEST OF CHARGING CURRENT OF TRUNK FEEDERS THREE-CORE, ·15 CABLE, 6·26 MILES TOTAL. ·50~.

P.D. between cores.	P.D. to neutral point.	Charging current, amperes.		Equivalent capacity of one core.
		Elec. dynam'ter.	Kelvin balance.	
1,600	924	2·09	2·2	·813
2,100	1,212	2·88	2·74	·735
2,500	1,442	3·37	3·24	·745
3,200	1,850	4·13	4·14	·713
3,700	2,135	4·47	4·5	·667
4,200	2,430	4·85	4·79	·637
4,900	2,830	5·34	5·19	·63
5,180	2,990	5·6	5·48	·597

Before leaving this question of the charging current taken by these feeders, it may be interesting to consider for one moment the relation of the alternator self-induction to it. Taking the alternator E.M.F. wave as being made up of a fundamental wave $e = \sin 2\pi n t$, where $n = 50$ periods per second, and a number of harmonics of frequency $= q$ times n, where q has successive integral values, we may express the E.M.F. wave as

$$e = \Sigma E_q \sin (2\pi q n t + c_q)$$

c_q being a constant, fixing the relative position of any particular harmonic with regard to the fundamental.

Now, if resonance occurs with any particular harmonic, it has been found that the current flowing is exactly that due to the frequency of the harmonic in question. Hence the current, C, charging the cable will be

$$C_K = 2\pi q n K V,$$

and the short-circuit current of the alternator

$$C_L = \frac{V}{2\pi q n L},$$

where K = capacity in farads and L = self-induction in henrys of one leg of the system. When these two currents are equal, we have the well-known condition for resonance.

Applying this condition to the case of a 500-KW. Dublin set coupled to the three trunk mains (9·3 miles of ·15 cable)

$$C_K = \cdot 337 \times 9\cdot 3 = 3\cdot 14 \text{ amperes,}$$

and $C_c = 145$ amperes, when q is unity.

The value of q, therefore, which will make $C_K = C_c$ is

$$q = \sqrt{\frac{145}{3\cdot 14}} = 6\cdot 77.$$

We might, therefore, expect to get resonance with the seventh harmonic, or a frequency of about 338.

Sub-Stations.—The average cost of a three-phase transformer appears to be about 20 per cent. less than that of a single-phase transformer of the same output and type. On the other hand, a certain amount of spare plant will always have to be provided, and if three single-phase transformers be used, one spare transformer

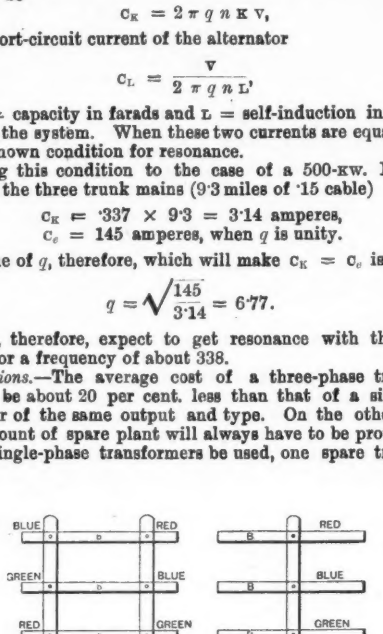


FIG. 6.

will act as an efficient spare to all three, whereas if three-phase transformers are used, it would in most cases be as economical to completely duplicate the plant as to multiply the number of transformers by using small ones of less efficiency and greater cost per kilowatt. The cost of transformers per kilowatt installed increases rapidly as the output is diminished. For instance, a 90-KW. transformer would cost about 28s. per kilowatt, whereas three 30-KW. transformers installed in place of it would cost 46s. per kilowatt.

Where a number of sub-stations are distributed over a large area, the question of weight is of some importance as regards transport and appliances for moving the transformers in the sub-stations. The three-phase has the advantage of the single-phase transformer in this respect.

TABLE III.—TEST OF OIL TRANSFORMERS, 50 ~ SINGLE PHASE.

Output of transformer in KW.	250	50	50	40	30	20
Ratio (volts)	5,000	5,000	5,000	5,000	5,000	5,000
	2,000	2,000	200	200	200	200
Magnetising watts	2,100	380	462	438	308	292
Copper watts	3,084	623	660	512	510	265
Total watts	5,184	1,003	1,122	950	818	557
Per cent. loss	2·08	2·0	2·24	2·37	2·73	2·78

The efficiency of the three-phase is usually less than that of the single-phase transformer. In good designs, however, this difference does not usually much exceed 1·5 per cent.

The three-phase transformer possesses the advantage of equalising the pressure upon an unbalanced load. On the other hand, if a fault occurs in a transformer, three or more times the amount of plant is thrown out of use thereby, than would be the case with a fault with single-phase transformers.

In Dublin we have not had the slightest difficulty as regards the banking of single-phase transformers in delta or star connection, transformers of 25 KW. output sharing the load proportionately throughout the range with transformers of 250 KW. output when banked with them, delta and star connected. The transformers in each of the 21 new three-phase sub-stations are of the oil-cooled type of the British Westinghouse Co.'s manufacture. The results of tests of some of these transformers are given in Table III.

The neutral wire from each cable-dividing box in the low-tension side is joined to a copper earth-bar, which is connected through a recording ammeter to an earth-plate. This earth-bar is situated in a cable trench in front of the low-tension board, where it is joined to three of the tails from the transformers star-connected and forms their neutral point. The remaining three transformer tails are connected through fuses and switches to three bus-bars indicated by colours, as the red, blue, and green phase respectively. Special attention has been paid to the arrangements for switching in a spare transformer with ease and certainty as regards its phase relationship to the other transformers. The conditions to be satisfied will be evident from the diagram (fig. 5). If A B C represent the high-tension bus-bars, and + − the spare transformer terminals, the connection must be made in one of the three ways shown to correspond to one of the three phases on the low-tension side. The arrangements made for carrying out these connections in practice are shown in fig. 6. In the centre of both high-tension and low-tension boards are placed plug connections of the well-known split-tube Ferranti type, actuated by a bayonet socket handle. All that is then necessary for the operator to do to replace a transformer, say, on the red low-tension phase is to insert plugs on the high-tension board in the two positions marked red, and the single plug on the low-tension board, making connection with the red phase, and then close the switch.

(To be concluded.)

THE STEAM TURBINE.

By WILLIAM CHILTON.

(Abstract of Paper read at Manchester, February 2nd, 1904.)

IN principle the steam turbine is a machine for directly converting into rotary motion a portion of the kinetic energy of steam.

There are two principal types of turbines—one in which nearly the whole available energy of the steam is used in an expanding nozzle to give to itself a very high velocity before being utilised in giving rotary motion to a wheel; the other in which the steam passes alternately through many rings of fixed guide plates and of revolving blades, and expands by a small amount during its passage through each ring, until it leaves the last row and is discharged into exhaust, having parted with the greater portion of its useable energy.

The De Laval turbine is of the first order, the Parsons of the second; the Rateau and the Curtis turbines combine some of the features of both.

All these turbines may be either of the parallel or of the radial flow type, but have mostly been developed on the former lines.

The velocity attained by the steam in the Parsons turbine, compared with that in the De Laval turbine, is low, as it depends on the small difference of pressure on the two sides of a ring of blades, and, as this pressure difference can be made very small, depending, as it does, on the number of rows of blades, it is possible to reduce the velocity of the steam, and therefore the speed of rotation of the wheel, to very manageable limits.

The Parsons Turbine.—The modern Parsons steam turbine consists primarily of a casing, which carries the stationary guide blades, and a rotor, or spindle, which carries the moving blades.

The rotor is carried by two main bearings, which are the only portions of the turbine proper subject to mechanical friction.

The casing is divided into three main portions, which may, for convenience, be referred to as the high pressure, intermediate pressure, and low pressure cylinders. Each of these is again divided into two or more stages of increasing diameter.

Steam enters through the regulating valve into a circular chamber, and first passes through a ring of fixed guide blades, which direct its path, so that, on leaving them, it glides on to the entrance sides of the moving blades absolutely without shock.

The moving blades, again, are so fashioned that the steam will flow without shock into the entrance opening of the next row of fixed guide blades, until it is discharged at the exhaust end, after having been expanded down to the pressure of exhaust, and issues into the exhaust chamber from the last row of moving blades without drop in pressure.

The differences of pressure on the two sides of the moving blades already mentioned produce an end thrust in the rotor. To balance this there are three dummy pistons on the rotor. The first and smallest balance piston balances the end pressure of the high pressure, the second that of the intermediate, and the third that of the low-pressure cylinder.

To keep the moving blades always in correct relative position to the guide blades, and also to take up any small unbalanced force, a thrust block is supplied.

The double-beat admission valve is attached to the piston of a steam relay cylinder, controlled by a piston valve which receives an intermittent reciprocating motion from a cam on the shaft. The position of the relay piston valve is controlled by an ordinary centrifugal spring governor in such a way that at light loads and at no load the exhaust is more fully open than at the higher loads,

and consequently the regulating valve is open to steam for shorter periods at the lighter, than at the heavier loads. At full and overload the valve is almost continuously full open.

One advantage of the reciprocating motion given to the valve and gear is that the whole of the governing mechanism is always "on the go," and is therefore ever ready to respond to even the slightest changes in the load.

Although at first sight this gear may seem to be of the cut-off type, an examination of the curves of total water consumption shows that these follow the Willans straight line law, which is the characteristic of throttle-governed engines.

A second governor, exactly similar to the first, controls a second double-beat emergency valve, which only comes into play if, perchance, the main governor fails to act. The emergency valve can also be controlled by hand.

A crankshaft, driven by worm-reducing gear, drives, as well as the cam already mentioned, the two governors by means of bevel gears, and also the oil pump which supplies oil under pressure to the two main bearings of the turbine and to those of the generator.

The weight of the rotor of a 1,000-KW. turbine is about 6,300 lbs., and is distributed in the proportion of about 2,830 lbs. on the bearing at the steam end, and 3,470 lbs. on the other; this gives a pressure per square inch on the area of the bearing (taking the area as length by diameter) of 38·5 lbs. on the first and 46·5 on the second, or a mean of 42 lbs.

The surface velocity of the journal varies from about 1,950 to 2,350 ft. per minute, or a mean of 2,150 ft.

Multiplying the mean surface speed per minute by the mean pressure on the bearings or 2,150 by 42 we get the figure 90,300. It is interesting to compare these figures with the corresponding ones obtained in high speed reciprocating engine work; pressure per square inch on main bearings 160 lbs., surface speed 575 ft. per minute, product of these two figures 92,000, or approximately the same as in the turbine.

The method of securing the blades in the rotor and the cylinder is effective and cheap. The blades are drawn to the correct section from a special mixture of brass, or from copper, in lengths of 12 to 15 ft., and are cut to the required length. Grooves about $\frac{1}{4}$ in. deep are turned circumferentially on the outer surfaces of the rotor and on the inner surfaces of the cylinder. The blades, after being cut to the correct length, are placed in the grooves in a radial direction. The width of the grooves is regulated, so that when the blades are in place they take up their correct angular position relatively to the axis of rotation. Caulking pieces of soft drawn brass and of a length equal to the depth of the grooves are placed in the grooves alternately with the blades;-first a blade, then a caulking piece, and so on, until the row is complete. The caulking pieces are then tightly caulked home into the groove with special tools. When finished the whole forms a piece of sound work very well adapted to the function it has to perform.

In some recent correspondence in the electrical papers, much was said about the ripping out of the blades, due to the fouling of the blades against the cylinder walls, or to the blades being drawn out of the grooves by centrifugal force, or to the deleterious action of superheated steam on the metal.

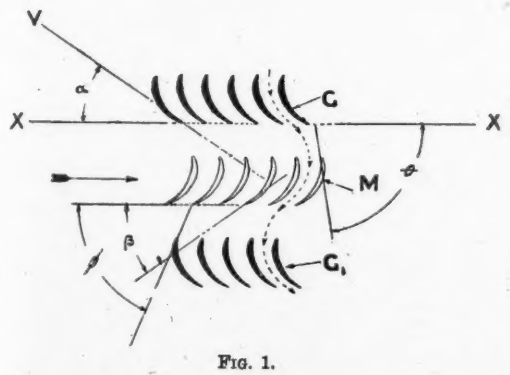


FIG. 1.

Blades have occasionally been ripped out, but accidents of this nature to the turbine are probably of less frequent occurrence than are accidents to reciprocating engines. There is, however, an important difference. Several rows of blades may be stripped from the cylinder or the rotor or from both, and no bad results ensue, the attendant, in fact, may not even be aware of the accident, the principal effect of which is a drop in the steam economy of the plant. The plant can still be run until such time as it can be shut down for repairs. But mishaps do sometimes happen to reciprocating engines, usually fraught with consequences more serious than the stripping of blades in a turbine plant. We look upon the reciprocating engine nevertheless as a reliable machine, and when steam users become more familiar with the turbine, they will look upon it as a machine at least as safe, and in many cases more convenient than the ordinary engine.

In all machines designed to abstract kinetic energy from a moving mass in an efficient way, it is most important that the mass should glide on to that portion of the machine, generally a rotating wheel, whose function it is to absorb kinetic energy, absolutely without shock.

That this may be so in the steam turbines we are considering, it is necessary to observe certain relations between the path of the steam and the angles of the blades, and also between the velocity of the steam and the speed of the blades.

In fig. 1, G, G_1, represent two rings of fixed guide blades, M, one ring of moving blades of a turbine. The arrow indicates the direction of motion of the moving blades. The line V represents the absolute velocity of the steam on leaving the guide blade, G, and the angle α indicates the direction into which the steam is guided by these blades in relation to the line X X, parallel to the plane of rotation of the moving blades. θ is the angle the side of the moving blade at entrance makes with X X, and β the angle between the sides of the moving blade at exit and the line X X.

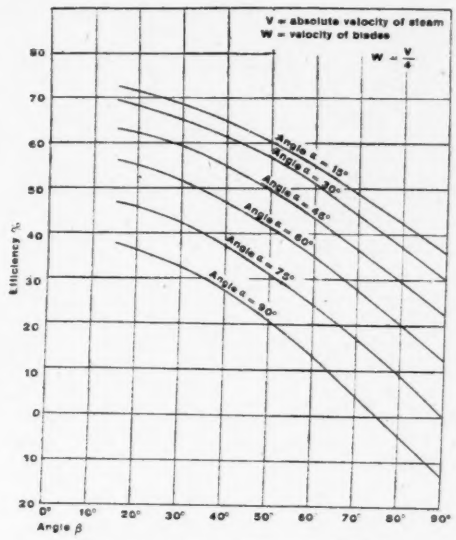

V = absolute velocity of steam
W = velocity of blades
W = V/4
Angle α = 15°
Angle α = 30°
Angle α = 45°
Angle α = 60°
Angle α = 75°
Angle α = 90°
Efficiency %
Angle β
0° 10° 20° 30° 40° 50° 60° 70° 80° 90°

FIG. 2.—BLADE EFFICIENCY CURVE.

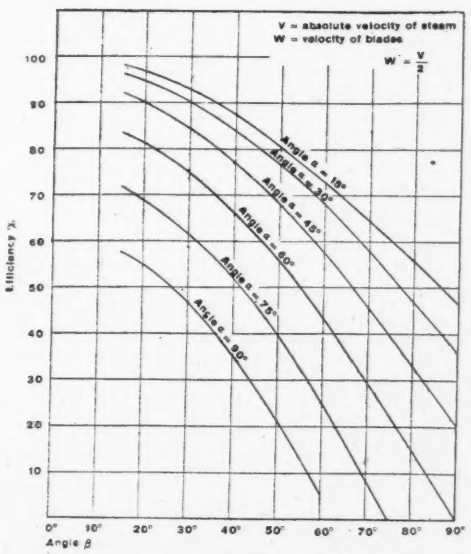

V = absolute velocity of steam
W = velocity of blades
W = V/2
Angle α = 15°
Angle α = 30°
Angle α = 45°
Angle α = 60°
Angle α = 75°
Angle α = 90°
Efficiency %
Angle β
0° 10° 20° 30° 40° 50° 60° 70° 80° 90°

FIG. 3.—BLADE EFFICIENCY CURVE.

An important relation is that between the absolute velocity, V, of the steam before it enters the moving blades and the speed of the moving blades themselves. This latter is always a fraction of V, and, generally, the larger this fraction the higher the efficiency of the turbine.

In practice the velocity of the moving blades is often one-half of the absolute velocity of the steam.

The angle α, the absolute velocity of the steam and the speed of the blades having been fixed, the entrance angle, θ, of the moving

blades must be formed so that the resultant path of the steam obtained by combining absolute velocity with speed of blades shall be parallel to the surface of the moving blades at entrance.

The steam will now flow along and parallel to the surface of the blade until it reaches the point of exit, making with the line x x the angle β. If free to choose this angle we will naturally make it so as to give as high an efficiency as practicable.

This angle, however, once fixed, the angle ϕ must be constructed so that the resultant path of the steam, obtained by combining the velocity of the steam at exit relatively to the blades, with the speed of the blades, shall be parallel to the surface of the fixed guide blades at entrance.

The shape of the curved portion of the blade between the inlet and outlet surfaces is not of much importance, provided it is smooth and takes the steam from one side to the other by a short and easy path.

The curves shown in figs. 2 and 3 give the theoretical efficiencies, not taking into account losses due to friction, to be expected from turbine blades with different angles of entrance and of exit.

The vertical ordinates represent percentage efficiency, the horizontal represent the angle of exit β of the moving blade.

Each curve is drawn on the assumption that the angle α is constant and the angle itself is marked on the curve, but the angle β varies from 15° to 90°.

All the curves on fig. 2 are drawn assuming the relation

$$\frac{\text{absolute vel. steam}}{\text{velocity blades}} = \frac{4}{1}, \text{ those on fig. 3} = \frac{2}{1}.$$

It will be seen that there is a large range of choice in speeds and angles, but that, on the whole, $\frac{\text{vel. steam}}{\text{vel. blades}} = \frac{2}{1}$ is the best, although when this ratio is even $\frac{4}{1}$, by making careful choice of angles, fairly good results may be expected.

It will be well for us now to institute a comparison between the steam turbine and the reciprocating engine.

(To be concluded.)

NEW PATENTS APPLIED FOR, 1904.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

1,846. "Improvements in electrical switches." G. Eason. January 25th.

1,847. "Improvements in the manufacture of electric cables and the like." J. Stratton and E. A. Claremont. January 25th. (Complete.)

1,848. "Improvements in the covering of electric cables." E. S. Seymour and E. A. Claremont. January 25th. (Complete.)

1,860. "Improvements in the working of an electric railway or tramway service." F. R. Boardman. January 25th.

1,863. "An improved incandescent electric lampholder and combined switch." J. S. Cunnington. January 25th.

1,884. "Improvements in electric cranes and the like." Stothert & Pitt, Ltd., and W. Pitt. January 25th.

1,952. "An improved automatic device for cutting off the electric current when a line wire breaks." F. Parker. January 26th.

1,964. "Improvements in and relating to apparatus for the production and application of electric oscillations." A. W. Sharman. January 26th.

1,968. "Improvements in motor control systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 26th.

1,973. "Improvements in electric telegraph systems." C. Adams-Randall. January 26th.

2,055. "Improvements in or relating to trolley pulleys and trolley heads for overhead electric traction." W. Cowell and A. Cowell. January 27th.

2,066. "Improvements in and relating to electric receiving apparatus for telegraphic and other purposes." J. T. Armstrong and A. Orling. January 27th.

2,091. "Improvements in systems of excitation for induction machines." M. Le Blanc. (Date applied for under Patents Act, 1901, January 28th, 1903, being date of application in United States.) January 27th. (Complete.)

2,096. "Improvements in or relating to apparatus for use in the distribution of alternating currents." A. F. Berry. January 27th.

2,119. "Improvements in and relating to electric tramway cars, omnibuses and other rail or road vehicles." T. Jones, Jun. January 28th.

2,141. "Improvements in the means or appliances for applying electricity and light for curative purposes." A. G. Witherby. January 28th.

2,202. "Improvements relating to electric tramways." J. Wilkinson and S. W. Mitchell. January 29th.

2,230. "Improvements in electric arc lamps." A. Eckstein and A. E. Angold. January 29th.

2,243. "Improvements in or relating to trolleys for collecting electricity." A. Thomson. January 29th.

2,274. "Improvements in telegraphic transmitters." W. L. Wise. (J. H. Peirce, United States.) January 29th. (Complete.)

2,277. "An improved electric low water alarm for boilers and the like." J. H. Sugrue. January 29th.

2,282. "Improvements in or relating to electric light fittings." E. Roberts and R. Mitchell. January 29th.

2,286. "Improvements in or connected with electric signalling apparatus for tramways and railways." R. P. Wilson and A. G. Marshall. January 29th.

2,307. "Improvements in electric arc lamps." Veritys, Ltd., and J. W. Ewart. January 30th.

2,315. "An improved electrical terminal attachment device." J. C. MacIver and A. F. Guy. January 30th.

2,344. "Improvements in electro-mechanical regulators." E. C. Hoegertaedt and R. G. Fothergill. January 30th.

2,347. "An improved composition for electrical conduits." R. Starke. January 30th.

2,362. "Improvements in and relating to coil windings for electrical apparatus." The British Thomson-Houston Co., Ltd., and A. S. Cubitt. January 30th.

2,363. "Improvements in automatic switches or circuit-breakers." The British Thomson-Houston Co., Ltd. (General Electric Co., United States. January 30th.

2,373. "Improvements relating to safety apparatus in connection with overhead electrical wires." E. Wakley and W. Harris. January 30th.

2,380. "Device for protecting a wire branch which depends from an overhead electric wire." O. A. Rosen. January 30th. (Complete.)

PUBLISHED SPECIFICATIONS.

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1902.

Anodes for Electrolytic Operations. M. d'Adrimont. 118. January 2nd.

Galvanic Cells. E. Friese. 382. January 6th.

Insulators for Electric Wires. S. G. Board and G. F. Freeman. 737. January 10th.

Rheostats. A. B. Rigby and E. G. Scott. 2,584. January 31st.

Double-Acting Arc Lamp Brake for the perfect Feeding of the Carbons at a Uniform Rate. 3,063. February 6th.

Radiators. M. Shearer. 3,460. Febuary 11th.

Electrically Igniting the Wicks of Miners' Lamps. W. H. Johnson and R. March. 3,686.

Arc Projecting Lamps. F. H. Loring. 3,751. February 13th.

Microphones for High-Tension Currents. R. Gaillard and E. Ducretet. 4,368. February 20th.

Trolley Frames for Use in Overhead Cars. W. Hunt. 5,043. February 28th.

Insulating Material. J. G. Maardt. 5,118. February 28th.

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Electric Switches. A. Vandam and T. H. Marsh. 5,130. March 1st.

Preparing Flattened Coils for Electrical Magnets, Solenoids, and other Purposes. 5,290. March 3rd.

Submarine Cables. F. Tremaine. 5,308. March 3rd.

Electric Accumulators. J. E. G. Meran. 5,366. March 4th.

Dynamos, Motors, and the Like. The Hon. C. A. Parsons. 5,374. March 4th.

Electrolysis of Alkaline Chloride Solutions. P. La Cour and J. C. Ruik. 5,718. March 7th.

Apparatus for Electric and other Cars, for Cleaning the Rails, removing Obstructions, and the Like. R. J. Plunkett. 5,759. March 8th.

Prepayment Gas or Electricity Supply Controlling Apparatus. H. Cooney. 5,851. March 10th.

Apparatus for Producing High Electrical Potentials and in Means for Utilising the Same for Ignition of Explosive Mixtures in Explosion Motors. E. Eisemann. 6,000. March 11th.

Measurement of High Electrical Resistances. O. Cox. 6,193. March 13th.

Brakes for Electric Tramcars. G. A. Trube and W. Chapman. 6,295. March 14th.

Electric Accumulator Plates. Accumulator Industries, Ltd., and J. J. H. Hunte. 6,304. March 14th.

Signal Telegraphs. E. Lavens and E. J. Lavens. 6,648. March 18th.

Electrical Locking Gear for Railway Signals. Siemens Bros. & Co., Ltd., and L. M. G. Ferreira. (Communicated.) 7,362.

Tumbler Switches. H. Hirst and H. Bevis. 7,401. March 27th.

Winding Gear for Mines. W. P. Thompson. (Communicated.) 7,590. March 29th.

Conduits. C. D. Budd. 7,893. April 4th.

Rontgen Ray Apparatus. J. M. Davidson. 8,202. April 8th.

Electric Light Cure Arc Lamps for the Treatment of Skin and other Diseases. R. Otto. 8,308. April 9th.

Electric Hand Lamp for use in Coal Mines. F. J. Turquand. 8,345. April 10th.

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Electric Motor Control Systems. British Thomson-Houston Co., Ltd. 8,558. April 12th.

Mechanism for Receiving Trolley Wires. W. A. McCallum. 8,794. April 15th.

Telephonic Apparatus. S. G. Brown. 9,044. April 18th.

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Fitting for Electric Incandescent Lamps. A. W. Beuttell. 9,488. April 24th.

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Electrolytic Production of Bleaching Liquor and Caustic Alkali Lye. A. J. Boult. (Communicated.) 9,812. April 28th.

Switch or Ringing Keys for Telephone Switchboards. L. M. Ericsson. 9,800. April 28th.

Electric Fuse Boxes for Street Mains. R. F. Hall. 9,825. April 29th.

Implements for Stripping Insulation from Wire. C. C. Sibley. 9,859. April 29th.

Electric Arc Lamps. Veritys, Ltd., and W. R. Ridings. 10,269. May 5th.

Controlling Electric Circuits. British Thomson-Houston Co., Ltd. (J. J. Wood.) 11,073.

1903.

Storage Battery Plates. E. W. Smith. 22,765. October 21st.

Producing a Suitable Circulation of the Electrolyte in Electrolytic Processes. H. Koller and P. Askenasy. 23,151. October 26th.

Electric Lamp Sockets. J. H. Goehst. 23,225. October 27th.

Electric Fuse Pillar Boxes. Callender's Cable Construction Co., Ltd., and J. C. A. Ward. 1,054. January 15th.

Electric Spark Plug for Explosive Motors. A. Herz. 2,152. January 23th.

Electrical Conduit Systems for Tramways and Railways. F. B. Aspinall and J. D. Dallas. 3,042. February 9th.

Trolleys and Trolley Poles. A. L. Tyerman. 3,204. February 10th.

Safety Electric Fuses. E. Mies. 3,988. February 19th.

Electric Switches. I. H. Parsons. 6,540. March 20th.

Electricity Meters. W. E. Evans. (Allgemeine Electricitäts Gesellschaft.) 7,485. March 30th.

Dynamo-Electric Machines. W. E. Evans. (Allgemeine Electricitäts Gesellschaft.) 7,384. March 30th.

Space or Wireless Telegraphy. W. P. Thompson. (J. S. Stone.) 8,507, 8,508 and 8,509. April 14th.